University of Alberta

"An Infrastructure Reconstruction Decision-Making Model for Postwar Situations."

by

John Bundu Fofanah

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ABSTRACT

Sierra Leone went through eleven years of civil war. The war devastation caused massive human suffering and widespread deterioration of the country's social, economic and infrastructure assets. Consequences of the infrastructure destruction bear a substantial negative effect on the quality of life of the citizens and continue to impoverish Sierra Leoneans. Reconstruction of the devastated municipalities after the end of the war in 2001 became the priority of the donors such as the United Nations and Developed Countries; including financial institutions such as the World Bank; the Sierra Leone government and local officials of the devastated municipalities. Each of these parties has separate agenda and distinct set of priorities with respect to rebuilding the destroyed infrastructure facilities in municipalities. The problem of the distribution of funding for reconstruction of the destroyed infrastructure facilities to municipalities through equitable and transparent framework, and to improving the quality of life of the citizens has been a major concern to all the stakeholders. The three years of reconstruction experience shows dissatisfaction from all the key players, especially the financing institutions.

The research provides a methodology which can be used in selecting postwar municipalities and public infrastructure facilities for reconstruction based on limited budgets. The researched was developed and tested in three distinct phases. Phase 1 was an assessment of five factors (capacity to sustain reconstructed facilities, donor procedures and practices, current infrastructure state, government and national priorities, and coordination effectiveness) which impact postwar reconstruction initiatives. Factors were analyzed in frameworks (1 to 5--sustainability capacity, donor procedures and practices, current infrastructure state, government and national proprieties, and

coordination effectiveness). Phase 2 integrated the analyzed output values of the frameworks using a fuzzy-rule-based approach. This approach provided a holistic assessment. In Phase 3, an optimization approach using a Lingo program was implemented to allocate facilities in municipalities competing for reconstruction funding. A linear model used four criteria values: output values of Phase 2, costs associated with reconstruction of facilities, constraints in funding limits, and limitations in the number of facilities for any category.

Findings indicate that the 5 frameworks, to varying degrees, provided a contribution to the selection process. Hence, the study aided decision-makers in allocating resources in devastated municipalities. The ultimate outcome was quality-of-life enhancement for citizens and communities. The research provides 3 key contributions to knowledge. By using the reconstruction impact model developed and tested in this study, donors will have a more stable, reliable, and credible means of allocating scarce resources to assist postwar reconstruction. The second contribution is having a research based model to make decisions for selecting projects for reconstruction. This model is based on theoretical understandings, research applications, and practical needs of both donor agencies and devastated communities. Thus, decision-making is taken out of the "best guess" and "most influential" scenarios and based on scientific data. The third contribution is an addition to quality-of-life social indicators based on human development factors. This research offers statistical data to complement these indices, thus enhancing the holistic approach to reconstruction.

This thesis is dedicated to my late father:
Pa-Alpha Fofanah

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CHAPTER ONE

1. INTRODUCTION

1.1 MOTIVATION

Over the past few decades, the quality of life for most people on the African continent has deteriorated dramatically. This condition is often attributed to brutal military or civil rulers, poor economic mismanagement, widespread famine, and environmental, political, and societal degeneration (Alli and Mathews, 1999). In the 1980s, civil wars symbolized the latest in a series of crises causing untold human suffering along with destruction of social and economic infrastructure. (A detailed description and discussion of the Sierra Leone situation is included in Appendix 1.) Infrastructure related problems have continually plagued municipalities of postwar African countries, especially in Sierra Leone, Liberia, Uganda, Somalia, Sudan, Rwanda, Mozambique, DR Congo, Angola, Burundi, Central African Republic, the Ivory Coast, Eritrea, Ethiopia, Guinea Bissau, Mali, Mozambique, Namibia, Niger, South Africa, and Uganda. More recently, concerns have emerged about the diminishing conditions of the infrastructure in these countries and how it can be replaced. In most cases, governments lack the necessary resources to replace decaying and/or destroyed infrastructural assets.

Moreover, these postwar countries have become an environment in which numerous foreign players are involved, some within the immediate sub-region, and some from much further a field. Articles have appeared in professional journals, usually from reports by donor agencies' representatives in the field and/or from local and international Non-Governmental Organizations (NGOs) attempting to outline frameworks for reconstruction of those municipalities devastated by wars. (For a list of donor agencies and NGOs operating in Sierra Leone, see Appendices 2 and 3.) Numerous attempts at reconstruction have failed as a result of poor decision-making or poor management practices (Sanders, 1973). Generally, in the face of limited resources and competing demands, government agencies lack well developed methods to determine how available funds should be directed (Crihfield and McGuire, 1997) in order to improve the quality of life of the citizens and communities involved.

Infrastructure is vital to all municipalities. It is the physical framework which supports and sustains all economic activities and which produces services central to quality of life (Grigg, 1994; Cain, 1997). It is important to understand that infrastructure in municipalities is not a single element or facility but a combination of several elements. Though authors differ with regard to the particular categorization, most agree that the following are included: buildings, roads and bridges, social arenas, transportation services, water and sewers, waste management, energy production and distribution, and communication (Grigg, 1998).

1.2 PROBLEM AND RESEARCH OBJECTIVES

The four years of official reconstruction in Sierra Leone (2003 – 07) have not alleviated the concerns among stakeholders (Kaldor and Vincent, 2006). Admittedly, reconstruction processes will usually encounter a number of obstacles. These include bureaucracy, limited funding, donor priorities, and local government policies. The Sierra Leone experience shows dissatisfaction from all the key stakeholders, especially the financing institutions. Citizens express concerns that infrastructure projects are targeted towards regions of the influential sect, while the needs of other regions are being ignored. Donors are concerned that the funds provided are not being utilized appropriately to affect improvement in the quality of life in a way that conforms to donor procedures and practices. The Government of Sierra Leone (GOSL) is concerned that projects are not being distributed among municipalities in accordance with national priorities. Owing to these issues, there is a tendency toward a continuing deterioration of the quality of life in devastated municipalities. Politicians, in an effort to satisfy their constituents and earn reelection, seek to ensure that projects are concentrated or directed to their regions. Meanwhile, the National Commission for Social Action, charged with the coordination of reconstruction initiatives in the country, asserts that they may wish to incorporate citizen and politician requests and complaints into the planning process, but there is not sufficient capital to satisfy these requests in addition to addressing all interests and needs.

The objectives of this study are threefold:

1. to identify factors that may be considered in a postwar infrastructure reconstruction management process, such as scale of destruction, sustainability capacity of

municipalities, donor procedures and practices, government and national priorities, and coordination effectiveness of stakeholders;

2. to develop a model to integrate these factors to quantify a holistic measure of impact on reconstructed facilities for citizens of devastated municipalities; and

3. to formulate a linear programming model to aid the allocation of infrastructure facilities for reconstruction to municipalities based on available funds, impact generated (see objective two above), and interdependencies of infrastructure facilities.

Achieving these objectives entailed identifying the stakeholders in postwar reconstruction, understanding the factors associated with stakeholder groups, and understanding their influences on the reconstruction process. More importantly, it involves measuring the outcomes or outputs of these factors in order to determine their effect in improving the quality of life in municipalities devastated by war.

1.3 METHODOLOGY

This research incorporates five factors of postwar reconstruction using a three-phase approach. Phase 1 analyzed the criteria which characterize the five key factors in postwar reconstruction (sustainable capacity, donor procedures and practices, current infrastructure status, government national priorities, and coordination effectiveness). Phase 2 provided insight into the integration of the factors utilizing fuzzy rules. Phase 3 provided a detailed analysis of an optimization model which assisted in the allocation of infrastructure facilities to municipalities for reconstruction. Because of the complexities of these factors, and the requirements to balance the concerns of the stakeholders, a detailed consideration of all components (using tools like AHP, Semantic Differential and Hamming Distance techniques, and fuzzy logic) was adopted in this research.

Overall, the methodology adopts the use of an impact-based evaluation that assesses sustainability capacity of municipalities (Framework 1), donor procedures and practices (Framework 2), current infrastructure status Framework 3), government and national priorities (Framework 4), and coordination effectiveness (Framework 5). A rule-based technique using fuzzy rules was used to integrate the outputs of the frameworks to obtain a holistic representation of the measure of impact on quality of life generated through the reconstruction of an infrastructure facility. The outputs of the integrated

model were used in a linear optimization (LINGO program) model to allocate funds and select municipalities for infrastructure reconstruction.

1.4 RESEARCH SCOPE

The management of postwar reconstruction initiatives and development constitutes a field where crude difficulties exist in attaining an operational level that is transparent, incorporates stakeholders' views, and is acceptable to those involved. The analysis of characteristic components of municipalities, donors, national governments, as well as destruction levels of infrastructure must treat each of these as a separate entity and, therefore, requires a stand-alone assessment of each component. However, a compressive and holistic approach to deriving a measure of impact of the results of the different methodologies in reconstruction is crucial.

The scope of this research was to develop a methodology which can render stakeholder needs and priorities, as well as a performance analysis of reconstructed facilities in improving quality of life of the citizens in devastated municipalities. The result, in turn, can be incorporated into a linear optimization model for the purpose of comparative evaluation of the different municipalities against the seven categories of infrastructure (education, health, water and sanitation, administration, security, transportation, and recreation and social activities). The main issue underscored by this work is that the allocation and manipulation of limited and scarce resources has to incorporate the components above and become one single objective.

A fuzzy rule based approach renders very good results in integrating both subjective and deterministic values. This is particularly applicable when a project is heavily constrained by either time or resources (Park and Pena-Mora, 2006).

1.4 THESIS ORGANIZATION

In this dissertation, information is presented and analyzed with regard to postwar destruction and the resultant infrastructure reconstruction management efforts. The process is not simple and the actors are many; desired results are scanty and have not been measured proportionately in devastated municipalities. Chapter two presents research documented on postwar reconstruction and related concepts, its definitations, key stakeholders, and, more importantly, how national governments, donors, and affected

citizens have responded to postwar reconstruction efforts. The chapter also provides a review of the key tools used in the reconstruction of postwar countries. This review identifies potential postwar reconstruction variables and provides the basis on which the identified tools are deemed suitable for this research. Chapter three describes the research design, selected variables, and the data set used in this study. The fourth chapter discusses the postwar reconstruction impact model and provides a detailed analysis of the procedures used in adopting the tools discussed in chapter 2. This chapter includes the description and implementation of an optimization model for allocating reconstruction funds and explains the model variables, interdependencies of infrastructure categories, and constraints common to postwar situations. The fifth chapter discusses the research findings/results of a case study of one municipality's infrastructure reconstruction situation. The sixth chapter offers conclusions and recommendations.

CHAPTER TWO

2. BACKGROUND AND LITERATURE REVIEW

2.1 STATE OF THE ART RELATED TO RESEARCH

Extensive work has been conducted to examine the extent to which decisions made by agents in public bureaucracies reflect the preferences of elected officials, interest groups, and private citizens (Balla, 2000). In this study, the decisions discussed concern the postwar reconstruction of infrastructure in Sierra Leone, West African.

2.1.1 Defining Postwar Reconstruction

Defining concepts such as postwar rehabilitation, reconstruction, and recovery has been of primary concern in research conducted by international organizations, governments, and NGOs. In order to provide a comprehensive description of the various factors underpinning development initiatives in the wake of civil conflict, many institutions and authors have attempted to define the term "postwar reconstruction." The World Bank (1998) defines postwar reconstruction in terms of the achievement of two objectives: the transition to sustainable peace and the generation of support for economic and social development. Kumar (1997), alternatively, has defined postwar reconstruction as the restoration of what existed prior to the conflict. Barakat (2005) has viewed postwar reconstruction as a range of holistic activities designed to not only stimulate economic and social development but also to create a peaceful environment tailored to prevent a relapse into violence. Cowen and Coyne (2005) have suggested that the reconstruction process begins with rebuilding a government and a political order. Post-conflict reconstruction, according to Kumar (1997), involves rebuilding both formal and informal institutions. He has emphasized that "reconstruction" should not be confused with "economic development," "state building," or "nation building." He has considered economic development to involve working within a given set of institutions to bring about change, while reconstruction requires rebuilding both formal and informal institutions. State building and nation building, the author has continued, can be seen as a subset of reconstruction and involves transferring governance capabilities. Coyane (2004) has contended that certain institutional prerequisites must be in place *prior* to the

implementation of a self-sustaining, liberally reconstructed order for it to operate effectively. These institutional prerequisites serve as the outer limits of reconstructed orders. They are the boundaries beyond which, the author has reaffirmed, reconstructed political, social, and economic orders will fail to operate as desired. Reconstruction according to Cowen and Coyane (2005) is therefore a problem in "public choice" and constitutional political economy.

2.1.2 Overview of Existing Postwar Infrastructure Management Systems

In this research work, infrastructure is referred to as the physical systems that provide education, health, transportation, water, security, and other public facilities needed to meet basic human needs, whether social or economic, within municipalities. Such facilities suffered considerable destruction during the 11 years civil war in Sierra Leone, for one. Since the 1990s, efforts have been made to better manage postwar infrastructure reconstruction. Reconstruction players such as the governments of the devastated countries concerned, the United Nations, the World Bank, and many others have adopted and/or modernized their respective Infrastructure Management Systems (IMSs) to reflect postwar conditions. The IMS was designed to provide a holistic or systematic approach to making cost-effective decisions about design, reconstruction, rehabilitation, retrofitting, maintenance, or abandonment of an infrastructure element (Grigg, 1988). The IMS is a multi-step endeavor that entails the following:

- an inventory of what is being managed,
- a condition assessment of existing elements,
- determination of funds,
- identification and prioritization of candidate projects when funds are constrained,
- a method to determine the impact of funding decisions on future condition and funding needs, and
- a feedback process (Lytton, 1991).

A key step in the IMS is condition assessment (Grigg, 1986; Habibian, 1994). These authors have argued that the key step involves the collection of data to identify type and severity of deterioration, structural integrity, functional adequacy, and safety of infrastructural elements. In postwar reconstruction situations, the identification and prioritization of candidate projects when funds are constrained is an equally important

step in the reconstruction process. The information on prioritization is vital not only to determine rehabilitation or reconstruction needs but also to assess which infrastructure facilities to select and in which municipalities. Collecting data to determine the condition of an infrastructure facility affected by war is a relatively straight-forward task. In most cases, elements of the physical facilities – whether roads, buildings, or bridges – will be visible and observable. In such cases, visual assessments are valuable indicators in asserting the current conditions (Smith, 2002). However, visual indicators may have limitations when attempting to replace infrastructure in a postwar setting. There is also a need to consider issues related to the nature and influence of stakeholders in postwar reconstruction processes.

One solution available to all decision makers is to integrate the effects of the following into a postwar reconstruction methodology: priorities of the national government, donor procedure and practice (protocol), capacity of the municipality to sustain the reconstructed facility, coordination effectiveness of stakeholders, and facility condition assessment. These five characteristics form the foundation of successful postwar reconstruction in that arriving at a better understanding of each would contribute to effective utilization of scarce funds, improvements to quality of life, and greater donor satisfaction. (An overview of the Sierra Leone decision-making structures and processes is presented in Appendix 4.)

2.1.3 Overview of Infrastructure Priority Needs and Funding

Adequate funding is a major factor constraining the capacity of municipal governments in war-torn countries from replacing devastated public infrastructures. Investment in infrastructure is generally seen to be low and lags behind growth in the municipal economy and population; since the relevant authorities are often short of funds and thus unable to adequately provide basic infrastructure (Rundolph et al., 1996; Nunan and Satterthwaite, 2001; Aryeetey, 2003). The financial constraint can partly be attributed to low income levels and poorly developed tax systems (Aryeetey-Attoh, 2003; Devas, 2003; Lohse, 2003). This issue of low investment in infrastructure in developing countries is not new (Arimah, 2005). With this funding indisposition, infrastructure investment projects require proper prioritization of needs and efficient implementation

strategies which take into consideration the multiple-criteria nature of the problem with its conflicting objectives (Ziara and Auyub, 1999). In an attempt to provide a solution to this problem, Zirara et al. (2002) have iterated that the structure for prioritizing infrastructure projects should integrate the views of different stakeholders involved in order to meet the goals outlined in national and donor policies. The result is a growing demand, especially among postwar developing countries with limited resources, to provide more services with fewer resources. Decision-makers involved in postwar reconstruction include national or cabinet committees, heads of involved agencies (e.g., ministries, local government, banks, execution agencies, governmental organizations, beneficiary institutions, etc.), executive directors of involved agencies, planners, engineers, contractors, and others (Ziara et al., 2002). The involvement of this wide array of decision-makers adds to the constraints associated with making priority decisions. In developing countries, these constraints may include inefficient institutional structures, lack of motivation, lack of sector data, or external and internal political influences (Alan, 2004; Ziara et al., 2002).

The provision of infrastructure requires a one-time financing source for initial capital investment and a continuous flow of funds to cover the costs of operation and maintenance (Fox and Porca, 2001). In developed countries, infrastructure is financed through public expenditure, private-sector participation, and user fees (Aziz, 1995). Central governments provide the bulk of infrastructure financing as 90% of the financial flow for infrastructure is channeled through government agencies (World Bank, 1994). At the municipal or local level, finance for infrastructure comes from internally generated revenue derived from a series of tax and non-tax services (Arimah, 2005). However, in developing countries, available evidence indicates that local government resource revenue usually falls below the expenditure required to provide the minimal level of infrastructure (Bird, 1995; UNCH, 1996; Bird and Uaillan-Court, 1998; Osei, 2002; Lohse, 2003). Consequently, municipalities have to augment their internally generated revenue sharing and, in a few cases, borrow from the capital market (Arimah, 2005). While this research supports these cases, it is pertinent to note that marked variations do exist in terms of the extent to which infrastructure is financed among municipalities in war-devastated scenarios in developing countries. These differences are driven by several

factors not yet fully understood by researchers in the field of infrastructure management. This is evident given that very few attempts have been made to link infrastructure funding with the various determinants at government, donor, and municipal levels.

Funding and, more specifically, international aid is a crucial component of the postwar reconstruction process (Coyne, 2002). In the wake of war-caused destruction, this service is provided by a mixture of short-term, donor-driven contracts for rehabilitation and emergency operations that do not lead to sustainable arrangements (Ian and Jordans, 2004). While funding from donors is clearly important, simply pouring money into postwar countries does not guarantee success (Pugh, 1998). The funds must be used effectively in order to have a positive impact. As has been iterated by Easterly (2001), simply committing financial resources to a developing country is no indication of success. In the absence of proper institutional frameworks, there is little point in investing resources in a large-scale rebuilding effort. Donor institutions like the United Nations, and developed countries (United States of America, Great Britain, Norway, etc.) have shown prominence in supporting reconstruction initiatives in war-devastated regions of Africa. In the spirit of humanitarianism and liberal internationalism, external organizations have assumed responsibility for building peace and development in war-torn societies (Pugh, 1998). Nevertheless, the dilemmas of external assistance are no less acute with respect to the transition from war to relative peace than with relief during war or in long-term development. The appropriate use of public reconstruction funds depends in part on the state of the institution that implements the projects (Ian and Jordan, 2004). The over-reliance on donor funding to finance infrastructure in war-devastated countries has resulted in a number of deficiencies.

2.1.4 Existing Research on Incorporating Stakeholder Inputs

Reconstructing war-torn societies involves multidimensional tasks that extend beyond mere physical and economic rebuilding. In order for reconstruction to be successful, it must be part of an overall strategy which integrates four elements: reconstruction, reconciliation, demilitarization, and effective multilateral engagement (Huarak, 1996). These elements are hinged on the involvement of all stakeholders in three key issues – coordination, resource mobilization, and donor commitment. Needless

to say, seeking the right partnership with stakeholders is a formidable task. It is not simply a matter of cost-sharing (Mbeki, 1999), but pertains to the entire reconstruction process, including decision-making and management. Towards this new form of postwar reconstruction partnership, President Mbeki (South Africa) outlined the following elements as crucial to the process:

- develop a policy framework for ensuring collaboration among ministries, NGOs, civil society, and other players;
- jointly plan, monitor and coordinate leadership, ownership, and implementation;
- share knowledge, information, technical know-how, and other resources;
- assume measures to build mutual confidence, respect, and accountability;
- involve the media and other stakeholders in public discussion on development issues;
- apply strategies to eliminate long-term dependency on aid, putting more emphasis on local capacity building and reliance on indigenous solutions;
- create a medium of managing and coordinating the partnership through legislation, consultation, and awareness meetings;
- involve stakeholders in building the minimum critical infrastructures for decentralization of implementation and management at various levels;
- channel assistance through credible UN and NGO; and
- collaborate in developing adequate data collection and information systems to assess the status and trends within the respective infrastructure categories.

Arguing in a similar vein, Coyne (2005) has suggested that to achieve a self-sustaining liberal order, a populace must coordinate around a set of conjectures that align with the overall aim of reconstruction. To this point, Lake and Harison (1990) have concluded that "the reliance on local planning and initiatives is a key important factor to postwar reconstruction" (p.4). Takahshi (2004) has also noted the importance of focusing on stakeholder inputs, coordination, and organizational design in order to provide leaders with a means of reaching consensus on measures to strengthen the management of state-building. Even in top-down approaches (Torabi, 2007), legitimacy is ensured when participation of local populations in programmes is part of the planning process.

Since 1997, postwar reconstruction players like UNDP have focused on accountability, transparency, and integrity in order to strengthen democratic governance by supporting research into the coordination dimensions of postwar reconstruction (Large, 2003). Dobbins et al. (2003) have offered a compelling argument suggesting that the reconstruction of Germany after World War II was successful because the United States accommodated the interests of the other occupying forces, while consulting with those countries that would be directly impacted by the political and economic status of Germany (Dobbins et al. 2003).

2.1.5 Existing Research on Service Delivery or Resource Allocation

Research about the effectiveness of governments and donors in postwar reconstruction has not been exhaustive. However, these proliferations of reconstruction players in postwar developing countries require a sound understanding of the theories and principles which underpin service delivery or resource allocation in a general perceptive. This area of research is broader and adds more depth to understanding the factors that influence government decisions regarding the allocation of services. Studies in this area may fall under one of two categories: economic or political (Jones et al. 1978; Viteritti, 1982). The emphasis of this research study will be on the political approach. This approach centers on the distribution of services to identifiable demographic groups, and asks who gains and who loses as a consequence of delivery practices (Viteritti, 1982). It is generally agreed upon among scholars that resource allocation patterns are virtually never evenly distributed across municipalities (Mladenka and Hill, 1978; Jones, 1980; Baer, 1985). Researchers' attempts to explain these distributional patterns have generated three predominant theories – bureaucratic decision rules, underclass or class bias, and political influence. These theories have subsequently guided investigations into service delivery as researchers test the applicability of these theories with a variety of different public service areas around the world.

Bureaucratic Decision Rules. According to the bureaucratic decision rules theory, the distribution of services is based on a set of professional criteria that bureaucracies use to determine "who gets what." These criteria should be immune to political, socio-economic, or other external factors (Jones et al., 1977; Mladenka and

Hills, 1978;, Lee, 1994). These authors have concentrated their research on the case of government distribution of goods and services to the citizens of Oakland, California (Levy, Meltsner and Wildavsky, 1974). One of the studies' stated objectives had been to determine why and how school, library, and street reconstruction projects were allocated among different groups. The authors found that several criteria were involved in the allocation of street reconstruction projects; reconstruction projects were under the control of the street department and they followed the department's decision rules. Though there was some political influence, it only resulted in shifting priority schedules. For libraries, a set of internal rules also governed the location and amount of resources allocated; these rules were based on user-ship. However, the results showed a distributional pattern that favored "well-to-do" areas, particularly those with scholarly interest and who used special collections. With regard to schools, when comparing class size, teacher salaries, experience, and salary dollars per student, the rules guiding these allocations resulted in a distributional polarization where neighborhoods at the upper and lower ends of the income brackets received the greatest benefits.

In 1977, Antunes studied the quality of roadways in Houston, Texas. His results revealed no evidence that racial or socioeconomic factors accounted for the unequal distribution of paved streets. Instead, the criteria for allocating street repairs were based on a set of internal rules that governed the providing agency, although not entirely (Antunes and Plumlee, 1977). An equity rule existed that required council members to receive proper allocations, by district, of all capital improvement money spent in the city. Accordingly, if any inequalities existed, they were the result of unknown factors. Bureaucratic decision rule was also the theory espoused in Mladenka and Hill's (1978) study of the distribution of police services in Houston. Their research has confirmed what other studies have touched on – that different municipalities or neighborhoods receive different levels of services. Neither socioeconomic status nor race accounted for the variation in police responsiveness. Rather, responsiveness was based on the severity of the offense. This way of prioritizing was based on an internal rule, and not on other considerations. However, the authors acknowledged that one cannot assume that the consequences of these rules will be neutral.

Mladenka, in 1978, decided to reexamine the role of organizational rules in decision-making along with their impact on the distribution of public services, specifically parks and libraries (Mladenka, 1978). This study included six cities in Virginia, with information aggregated at the census tract level. Mladenka has noted that there were no clear cumulative inequalities; rather, a set of operational rules existed that had distributional consequences. These rules merely simplify the choice between alternative solutions, reduce uncertainty, make for easy application and reliable performance, limit discretion, continually relying upon existing agency records and information. He has noted that the reason he focuses on the impacts of services rather than on facilities is because municipalities or neighborhoods change with more ease and regularity than physical facilities. Therefore, the current municipality may not resemble the municipality that existed when the services were built.

Mladenka further explored the distribution of services in 1980. This time, he looked at the distribution of parks and recreation, fire, refuse collection and education in the city of Chicago. Again, he had found little evidence to verify the influence of political or socioeconomic factors. He determined that the pattern of service delivery was more a function of past decisions, population shifts, technological change, reliance on technical-rational criteria and professional values (Mladenka, 1980). He did acknowledge that the determinants of distributional outcomes varied across different types of bureaucracies. The government agencies he had selected allowed little room for discretion; thus, organizational rules were a better explanation of who gets what.

Jones et al. (1978) attempted to show that the distribution of services poses political consequences even if the internal decision-making process is governed by a set of agency rules. Their study of three agencies in the city of Detroit revealed the decision rules followed did have distributional or political consequences. However, the nature of the impact and the characteristics of the resulting distributional patterns varied from agency to agency. They had concluded that to better understand the distributional patterns of a given agency, one should study the internal structures and processes of that agency. Nivola's (1978) study of housing inspection in Boston has revealed that conventional views of service distribution, i.e., underclass and politics, need to be reconsidered. He has concluded that the distributional patterns have little to do with authoritative policies or

political influence. Instead, housing inspection service patterns are dictated by internal imperatives of the administrative process. Unfortunately, these distributional patterns reflect a system of initiatives which are continually rationed and which limit activity.

Sanger (1982) analyzed the determinants of New York City's service distributions for fire, police, and sanitation between 1969-1970. Neither the underclass nor a need-based ecological hypothesis satisfactorily explains sufficiently the distributional patterns she observes. The bureaucratic decision rules hypothesis provides a more consistent and useful explanation of how services are distributed. However, she has pointed out that while other theories explain outcomes, the decision rules theory really only explains the *process* by which outcomes come about. This fact renders the decision rules a residual theory as the content of the rules is very seldom known. In fact, these rules could embody principles suggested by the other theories.

Class Bias Theory. The underclass or class bias theory is one of the first theories proposed in service delivery / resource allocation (Lee, 1994). It states that the distribution of services discriminates against either minority or lower-class municipalities or neighborhoods and favors those neighborhoods dominated by the upper-class or non-minorities (Lee, 1994; Cingranelli, 1981). In 1981, Cingranelli studied the distribution of police and fire protection in Boston. He has concluded by noting the difficulty with which a single variable or set of variables may be selected when attempting to explain the distribution of services. However, he believed that given a "need for services" and when studying comparable neighborhoods, the race or underclass theory is the best supported (Cingranelli, 1981). Cingranelli and Bolton revisited the underclass hypothesis two years later. They have proposed that earlier studies are flawed in three areas: the use of inappropriate measures of municipality or neighborhood need, analysis of limited variables, and failure to study comparable municipalities or neighborhoods (Bolotin and Cingranelli, 1983). By incorporating these modifications into their study of the distribution of police services in Boston, they have found evidence to support the underclass hypothesis.

Feiock's (1986) research has taken a slightly different approach. He has criticized earlier works for failing to measure provision of services in relation to the tax burden. His study has looked at elementary education in Erie, Pennsylvania in order to test the

application of the underclass hypothesis by examining distribution of service benefits and tax burdens resulting from provision of a service. His findings have revealed a regressive relationship in the provision of services. The net incidence of education is related to the socioeconomic status of municipalities, a correlation which further supports the underclass hypothesis.

In 1989, Mladenka was not satisfied with the answers provided through research, his own work included, on urban service distribution. Among his criticisms were that previous studies did not look at distributional patterns over time, that they failed to use multiple-indicators, that they did not take into account demographic shifts, and that they failed to define or elaborate on decision rules to determine whether or not they were truly racially or economically neutral (Mladenka, 1989). He had studied parks and recreation facilities programs and expenditures between 1962 –1983 in Chicago. He had used multiple indicators of recreational resources and services, aggregated his data by wards, and supplemented the data with interviews. Mladenka's conclusion does identify race as having been a factor, but only in the early 1960s. After 1967, changing demographics and other social changes altered the distributional patterns. His study has shown that, since 1967, home-ownership has been the primary factor governing service distribution.

Talen (1997), in a more recent study, has applied exploratory spatial data analysis techniques (ESDA) to the issue of service distribution patterns. She has measured accessibility (in distance) to park facilities in Macon, Georgia and Pueblo, Colorado. Her goal has been "to determine whether political or other factors account for a distributional inequities" (p. 8). The results of her research have added a physical or spatial dimension to ongoing research in this area. It has also provided support for the class bias theory.

In summary, research has identified and provided evidence in support of three key factors that influence or affect the equitable distribution of services: discrimination against minorities or lower classes in favor of those neighborhoods or municipalities dominated by upper-class or non-minority; the socio-economic status of municipalities or neighborhoods; and changing demographics and other social changes (a factor which bears a direct correlation to population size of municipalities). This work addresses these issues and provides a methodology which considerably minimizes their effect on postwar service distribution.

Political Influence. The Political Influence theory supports the contention that the distribution of services reflects the electoral considerations of politicians (Lee, 1994). These considerations are influenced by external forces that can include civic pressures or reelection issues (Meier, Stewart and England, 1991). Jones (1981) has analyzed the role of intermediary groups in the delivery of public services, using Chicago's Department of Buildings. His objective has been to determine whether citizens are linked in any way to the service bureaucracy through mediating structures and whether these linkages affect the distribution of services. His results have revealed the influence of political party structure at all stages of the service delivery process. He has attributed this trend to three factors: the nature of political culture, the agency's penetrability or openness to political influence, and the nature of the agency's service product.

Previous studies had not convinced Abney and Lauth (1982) that politics does not play a role in the distribution of services. In 1982 they conducted a survey of municipal department heads in US cities with populations of 50,000 or more. The respondents were asked to indicate factors affecting their decision about service delivery and rule enforcement for delivery of service. Results have shown that the organizational culture dictates whether political influences will affect the administrative decision-making process. Support for political influence in the distribution of services has been provided by Koehler and Wrightson in their 1987 reanalysis of Mladenka's 1980 study of Boston park services. They have changed Mladenka's study design by adding the two exogenous factors of population mobility and the short-term mobility of facilities. They have found that politics does indeed have an influence in the distribution of services. Their conclusion has been that population mobility coupled with immobility of certain park facilities has led to an underestimation of the impact of politics in the allocation of park facilities.

Meier, Steward and England (1991) also seem to have believed that politics plays a role in the distribution of services. One of their major criticisms of previous research on service distribution has been that it focuses on only a few cities and a few policy areas. They argued that it would be better to analyze one city over a long period of time or incorporate several cities into one study. Thus, their research has examined educational access in 140 school districts across the United States, his selection of education

stemming from a belief that it would likely be controlled most by bureaucratic decision rules and least by electoral politics. The authors found that bureaucratic decision rules do not override the impact of political forces or social class biases. In cases where bureaucratic decision rules have been established, thus preventing bureaucrats from adjusting services to meet either political or social ends, decision rules determine policy. However, where there is room for discretion, political forces clearly exert influence.

The objective of Rowan and Tunyavong's (1994) research has been to reexamine the role of distributional politics. Using the City of Chicago, they have analyzed the distribution of Community Development Block Grant (CDBG) funds over a 15-year period and Capital Improvement Projects (CIP) over a 6-year period. Their findings have verified the presence of political influences in service distribution. They have concluded that considering who "rules" really does matter with respect to development, that the use of a particular program for political purposes can occur over short periods of time. Elected officials can be selective by choosing certain programs for political purposes, so that only when it is not to their benefit do they allow bureaucratic decision rules to reign.

Ghobarah et al. (2005) have iterated two ways in which politics affects public health service in postwar situations. First, health services may not be devoted to the municipalities, groups, or communities with the greatest need. Lower income municipalities are often at a greater risk with regard to health problems and therefore are in greater need of public health services; yet, these municipalities are likely embroiled in political competition for scarce services. The authors have concluded that, consequently, health care services are skewed in favor of wealthy segments of the population who are generally healthy and less at risk. A similar reasoning has been presented by Evans et al. (2000a) that an educated population is likely to be more knowledgeable about health risk factors, to support greater expenditures for health care, and to utilize health care services more effectively. Ghobarah et al. (2005) have argued that the desire on the part of political leaders to retain power also plays a part. In order to stay in power, they must form a winning coalition among those who are politically active. To do so, they must satisfy a wide range of supporters and respond to broad demands for the public well-being (Olson, 1993; Bueno de Mesquites et al., 2003; Lake and Baum, 2001).

Overall, the role politics plays in service distribution is crucial. Political officials can be selective by choosing certain programmes (or projects) for political reasons; they are clearly an exerted influence. The level of education of the citizenry in municipalities or neighborhoods is also presented as a factor influencing service distribution. In chapter 4, the factors are discussed and a framework is presented on how these effects are incorporated into the methodology.

Additional Studies. In addition to those previously discussed, there are a number of studies which propose alternative theories or otherwise address service distribution issues. Lineberry's (1975) study has attempted to conjoin the issues of public service distribution and equity. Using as case studies fire and public parks, he has found little or no support for the Class Bias theory. What he has discovered are un-patterned inequalities. He has concluded that service delivery, as a result, will likely vary from city to city and from service to service (Lineberry, 1975). Boyle and Jacobs (1982) have offered a critique of earlier service distributional studies on the basis that equity has not really been defined in these previous studies, that the range of service outcomes is limited, and that only a simple bivariate correlation has been used. Therefore, in their 1970 study of New York City, they decided to apply a multiple regression model to a cross sectional analysis of 62 community planning districts and cover six different services. What they found was a definite difference in types of services and distributional explanations. The distributional patterns of property related services such as fire, sanitation, and police are best explained by the contributory hypothesis. This hypothesis states that "municipal services will be distributed in proportion to tax contributions" (p. 16). Distribution patterns for such social services as health, welfare, and education are best explained by the compensatory hypothesis which states that "municipal services are distributed on the basis of need" (p. 31). Boyle and Jacobs have further commented that studies which find no clear distributional pattern and attribute this to decision rules have possibly overlooked or omitted important explanatory or external variables. They have stressed that to believe that there are no external influences on service distribution is simply unrealistic.

The purpose of Nardulli and Stonecash's (1982) research has been to provide a theoretical framework for posing or evaluating any theory of service distribution. As they

have asserted, previous research has neglected a number of very important logical questions pertaining to possible influences on distribution. Accordingly, they have posed a series of five questions to consider if a general theory or expectation is to be formed for a specific city service. The questions, in suggested order, are as follows:

1. What is the nature of the service (can the service be unequally distributed)?
2. What is the nature of the bureaucracy (it is susceptible to political influence and/or does a bureaucratic policy exist)?
3. What are the rules of allocation which the organization uses?
4. If the bureaucracy is susceptible to external influences, what sorts of political linkages exist?
5. What are the distributional patterns desired by the bureaucracy?

These researchers have made the case that it is rather too simplistic to dichotomize influences on distribution. The rules governing service distribution may be varied; therefore they have noted that more care must be taken in interpreting these rules.

Baer (1985) has attempted to clarify why it is that various studies have generated such disparate outcomes. In his research, he has differentiated between labor-intensive services and capital-intensive services. Labor-intensive services such as police, fire, and trash collection are typically routine, repetitive, and recurrent; of short duration and revisable or even reversible if change is desired. Funding for these types of activities usually comes from a city's operating budget. Capital-intensive projects such as land acquisition, street construction, and water line replacement are infrequent, continual, long-lived, and non-reversible. Such projects are often paid for from special funds. Baer's contention is that studies which have supported bureaucratic decision rules as a basis for distribution patterns are really looking only at labor-intensive services. Decisions for capital-intensive projects reflect more political influence because they are often made in consultation with politicians, the public, and other bureaucrats. Furthermore, funding for such projects requires well-articulated and publicized justifications of distributive decisions.

Another attempt to resolve the conflict between the three theories (bureaucratic, underclass or class bias and political) has been made by Jong-Wha Lee (1994). Using data on service distribution from several agencies in New York City in 1980, Lee devised

a service typology that categorized services by type and function. His study has concluded that for administrative services, bureaucratic rules govern. For mixed services either the political or class bias model would be more appropriate. Political services, which are highly susceptible to external influence, favor high income or politically active communities. However, objective criteria, service needs, and conditions prove to be more important determinants of service distribution, regardless of the service type.

In conclusion, service distribution and equity bear some relationship and vary according to the type of service or locality (city, neighborhood, municipality, etc.) based on need. Another factor which has proven to be an important determinant of service distribution is "source of funding" (whether government operating budget, city/municipality, donor, special fund, etc.).

2.1.6 Sustainability Issues in Postwar Reconstruction

After having suffered the ravages of war, countries have desperate need for water, power, telecommunications, and transport services, not only to improve the quality of life but to remobilize the economy (Bannon and Schwartz, 2004). These authors have offered a compelling argument suggesting that services be provided by a hybrid of short-term, donor-driven contracts for rehabilitation and emergency operations that do not lead to sustainable arrangements.

Sustainability is a concept originating from the global movement, a way of thinking which advocates better management of resources (Horvath and Mathews, 2004), and with roots in the sustainable development movement (Cywinski, 2001). A 1987 United Nations World Congress document (called the Brundtland Report) has defined sustainability as "management of resources such that current generations are able to meet their needs" (Goley, 1996, 2). For the purpose of this research, three more detailed definitions are relevant:

- Sustainability development is a process of change in which investment, orientation of technology, allocation of resources, and development and functioning of institutions meet needs and aspirations without endangering the capacity of natural systems to absorb the effects of human activities. Also important is that these activities need to not compromise

the ability of future generations to meet their own needs and aspirations (McIsaac and Morey, 1995).

- Sustainable development is a system of changes in public attitude and policies such that activities of a community may be continued into the indefinite future without robbing the community of its useful resources (McWhorter, 1998, p. 3).

- Sustainability is related to the quality of life in a community, ensuring whether the economic, social, and environmental systems of that community are providing a healthy, productive, meaningful life for all community residents, present and future (Darlington and Simpson, 2001, p. 6).

Research on sustainability has been substantial. Ochoa et al. (2005) have focused on life-cycle assessment for residential buildings. Guggemos and Horvath (2005) have developed a decision support tool for environmental analysis of commercial buildings. Gambatese and Rajendran (2005) have examined sustainable road construction. El-Diraby and Wang (2005) have looked into the use of a semantic model to represent sustainability aspects of highway projects for local communities. The technical problem of sustainability emerges because of a contradiction between desires for a high quality of life and the requirements of sustaining the environment (Cywirski, 2001). Hence, Dreger (1996) has inferred that the issue of sustainability is as complex as it is broad and is often difficult to quantify. Public investment in infrastructure in Sierra Leone has been characterized by the inability to recover from service beneficiaries (Arimah, 2003). This is because user charges barely cover the cost of service delivery, payment collection systems are inefficient, rates of default are high, and service provision is characterized by an elaborate system of subsidies (Malpezzi, 1990; Choguill, 1996; Rizzo, 2002). According to Swaminadhan (1996), sustainability processes are governed by three basic views:

- "Careful maintenance of the delicate balance between productivity parameters and conservation practices";

- "Development strategies which are eco-friendly, energy efficient and waste minimal"; and

• "Economic models optimizing growth subject to ecological, economic, social and cultural constraints" (p. 12).

In the construction industry, incorporating sustainable development considerations into engineering analysis and alternate solutions is vital (ASCE, 1995). Sustainability, according to researchers (Dreger, 1996; Cywinski, 2001), is said to be based upon five pillars: conservation of nature, health and safety, reduced use of materials, social ecology, and cultural ecology. Other aspects presented by Cywinski, which include education and knowledge, ethics and culture, and values of heritage, are equally pertinent to postwar reconstruction sustainability. The discussion on sustainability of civil infrastructure systems has focused on the integration of organizational, financial, informational, and technical approaches (Aktan et al., 1997) to maintain or change infrastructure systems in a planned way during the lifespan of the given asset. Sustainability has been discussed in the context of life-cycle engineering, technology investment, performance measures, and project management, taking into account the interactions between these dimensions (Cywinski, 2001). Various authors (Schaub and Pavlovic, 1986; Cywiski, 1997; Brennan, 1998; McWhorter, 1998; Whitebeck, 1998) have noted that sustainability must be considered primarily from a philosophical, ethical and cultural point of view. However, this research has also opined that, in order to observe the principles of sustainability in postwar reconstruction, not only are professional, donor, and government commitment vital, but the major input of citizens is also critical. As such, these citizens should acknowledge the call for reconstruction of facilities.

By virtue of the experiences of recent natural hazards and disasters across the globe, a call for the inclusion of disaster losses as indicators of community sustainability has become necessary (Darlington and Simpson, 2001). Mileti (1999) has illustrated that sustainability in communities must include those future losses of environmental resources which can be anticipated and which it is willing to bear, and should ensure that disaster and redevelopment policies adhere to the goals of sustainable development. Therefore, sustainability is inconsistent with piecemeal solutions since such approaches tend to create groups with conflicting and/or competing interests, focusing on short-term benefits without monitoring long-term results (Darlington and Simpson, 2001).

The August 2007 Mississippi River bridge collapse (Minneapolis) and numerous other examples in recent memory point to the need for pre-planning for natural disasters. Although the impact of such events is enormous, planning in anticipation of such occurrences can be meaningful. It creates clear vision, goals, and a pre-planned framework for availability and effective allocation of resources. It provides a robust, swift, and guaranteed response. A similar discussion can be presented with respect to the Katrina hurricane disaster of 2005, referred to by analysts as the costliest and one of the deadliest hurricanes in United States history.

In postwar reconstruction, there is a need for the integration of donor, government, and municipality perspectives which considers the links among the sustainability capacities of various municipalities, the scale of destruction, and other influencing factors. These linkages must be considered as contributing to improving quality of life. However, questions still remain concerning the sustainability of most postwar reconstruction projects. Development decisions require a process of tradeoffs between sustainability issues and the economic demand for such facilities (Chong et al., 2006). A successful creation of sustainable infrastructure systems requires a holistic, integrated, and multidisciplinary approach (Adeli, 2002).

In summary, sustainable initiatives need to be incorporated into reconstruction in order to meet present needs and aspirations without compromising the ability of future generations to meet *their* needs and aspirations. Having said that, factors which characterize the philosophical, ethical, and cultural viewpoints of citizens, donors, and governments must be considered in the analysis of sustainability. Integrating sustainability in forefront planning has been shown to be a relevant and appropriate approach to a robust response to natural and manmade disasters. These issues are adequately assessed and provide inputs to the research methodology.

2.1.7 Reconstruction Models

Current models reviewed on post-conflict reconstruction of developing countries focus on addressing the causes of civil conflict, such as poverty reduction, governance, and corruption. Nafzier et al. (2000) and Stewart (2003) have researched conflicts on the basis of state failures resulting in government instability. It seems self-evident that

various methodologies adopted in developing countries on post-conflict reconstruction would encounter unfavorable outcomes. The first detailed allocation model in a postwar situation has been formulated by Paxson and Schady (2002). This model has been used to distribute spending on school infrastructure in Peru. The Peruvian government attempted to target social investment (in education) to the poor. This strategy involved constructing and renovating classrooms and sports facilities and providing text books and other educational materials to students. The authors have considered two features as particularly important in the selection of a community as recipient of an infrastructure project: demand-driven and targeted nature. The funding institution approves proposals prepared by communities for funding and releases funds to a group of community members elected for the stated purpose. The core issue presented by the authors has to do with how to target the investments. For this endeavor, a poverty map is used to allocate resources, along with an index measuring district-level poverty.

Somalia's post-conflict reconstruction demonstrates the consequences of an incompetent approach to nation-building (Viswanathan, 2004). Viswanathan's explanation of reconstruction failure has centered on a disregard for three important rebuilding strategies:

- the enormous humanitarian crisis blinded international parties to the fact that the root problem affecting reconciliation was political in nature;
- the international community was not eager to put forth the significant monetary and troop commitment that successful nation building required; and
- a significant proportion of the Somali people were not incorporated into the rebuilding effort (i.e., the importance of representation in Somali politics was not recognized as critical and essential).

Bosnia and Herzegovina's example, as illustrated by Cox (2001), also lacked the necessary attention vital in the reestablishment of institutions. This ultimately became an important limiting factor for the reconstruction programmes, manifesting itself in four deficiencies:

- failure to establish national authorities to take over the operation and maintenance of facilities;
- weakness of constitutional structures;

- problems associated with the reality that international agencies charged with carrying out the urgent implementation of various programmes had little choice but to work with whatever authorities were in place at the time; and
- the reality that during previous phases of reconstruction, collaborative action had been initiated directly with nationalist parties, ignoring the proper constitutional channels.

Anand (2004) has presented factual information about the proper establishment of infrastructure priorities for post-conflict reconstruction, elaborating on how a particular infrastructure strategy might contribute to conflict prevention. Sector programmes such as education, health, justice, defense, agriculture, roads, water, power, public administration, community development, private sectors, and finance were each examined for their value in an effort to enhance rapid physical reconstruction. Anand has narrowed his study on the restoration of peace and stability in war-torn regions to the following areas:

- the restoration of service delivery;
- the establishment of sustained policies and institutions; and
- the building of technical and managerial capacities.

Anand's model also adopts strategies which examine the impact of the sector programmes on poverty reduction, effective governance, peace, and conflict prevention. Any shortfall of this model stems from the fact that it does not provide a methodology for the effective restoration of delivery services, a mechanism critical to postwar reconstruction.

Developmental models for Angola (Cain, 2004) have followed both community-based and civil society rebuilding approaches. The lessons learned demonstrate that working together is a necessary step in resolving practical problems and achieving general objectives. Here, as well, a comprehensive approach integrating the various contributing factors that ensure the successful reconstruction of devastated municipalities in a sustainable manner was not provided. In general, an abundance of tools and techniques for postwar reconstruction have been developed during the last three decades which can be applied in order to restructure municipal or community preferences and values (Mollaghaseni and Pet-Edwards, 1997). Ziran et al., (2002) have provided a

formulation of strategies in the form of guidelines for the prioritization of projects to aid the decision making process. The guidelines use a risk-based Analytic Hierarchy Process (AHP) methodology, which incorporates potential outcomes of projects through their respective life cycles. Other tools such as scoring methods, utility based methods, goal programming, and fuzzy-based techniques have been used to address "prior articulated preferences" (p. 7). All of these approaches depend on improved tools that are scientifically defensible, practical, within the public domain, and comprehensive in nature in order to evaluate sustainability (Horvath and Mathews, 2005).

The shortcoming in incorporating sustainability is a lack of extensive studies in infrastructure sustainability and financing, which in part is ascribed to the absence of appropriate data at the municipal level (Flood, 1997). The greatest obstacle in formulating an effective strategy for postwar reconstruction is the lack of sufficient historical data on destroyed infrastructure and its effect on the quality of life. In many cases, data may simply be unavailable or inconsistent due to of the absence of any effective data collection methods. As a result, some researchers employ fuzzy-based techniques or other decision-making tools for which appropriate data are scarce. Fuzzy set theory is enjoying wide popularity in various applications which include management, economics, and engineering (Zadeh, 1994); this is explained in greater detail in subsequent sections of the chapter. However, there is little or no reported research on the application of fuzzy-based techniques in this area of postwar reconstruction. Although fuzzy set theory deals with imprecise information, it is based on sound quantitative mathematical theory (Chen and Hang, 1992). This study addresses the consequent shortcomings in the context of reconstruction.

2.2 CONTRIBUTIONS OF THIS RESEARCH

The majority of research on postwar reconstruction seeks to identify stakeholders and analyze infrastructure categories, including the bureaucracy's initiative for reconstruction. The research contribution is in three folds:

1. The holistic effect of complex factors associated with stakeholders (including the citizenry) on public policy, on the other hand, has received little attention (Rosener, 1978; Potter and Norville, 1983; Thomas and Melkers, 1999). This study expands on

what is known about government and donor response to postwar reconstruction by determining the influences of these players in affecting quality of life and long-range policies in reconstruction.

2. This research also contributes to the body of knowledge on service distribution. Although there are a number of studies on service distribution patterns, that research also presents some gaps which should be addressed. The gaps addressed in this study include: a review of the internal structure and process of the agencies engaged in postwar reconstruction as part of a broader evaluation of distribution of services (Jones et al., 1978); an examination of the rules embodied within the agencies (Sanger, 1982); and a study of a particular devastated district, including agencies' services provision intended to help detect changes in distributional patterns.

3. In addition to research on service distribution, this study analyzes the decision-making process with regard to current repair/replacement allocation of infrastructure facilities (i.e., activities of the commission charged with reconstruction). It is now evident that infrastructure decision-making models can no longer be regarded solely as a technical issue (Rittel and Webber, 1973). However, it is unclear just how non-technical issues are being incorporated into current decision-making processes. Accordingly, this research helps to determine how non-technical issues are being integrated into the infrastructure policy-making process.

2.3 INTRODUCTION TO THE PROPOSED TOOLS USED IN THE RESEARCH

Since this research is focused on assessing the key criteria influencing investment in postwar infrastructure reconstruction along with their potential effects on the selection of physical project facilities (and considering unavailability of historical and credible data), it is important to select the oppropriate techniques, given all limitations. For this study Analytic Hierarchy Process (AHP), Hamming Distance, Semantic differential technique, and Fuzzy theory provide the application tools and are presented in detail. This chapter also discusses other tools related to the issue of public service infrastructure facilities distribution, including the reasoning used to select different approaches to handle the different elements and/or sub-problems.

2.3.1 Analytic Hierarchy Process

The AHP is a decision-making methodology that involves setting priorities (Saaty, 1985). The tool was used as a deductive approach (Wong and Wu 2002) in a study involving geographic targeting of municipalities to reach priority ratings of infrastructure facilities. According to Saaty, the adoption of the AHP was based on its capacity to assist with the following:

- to break down criteria into manageable and measurable components;
- to provide a framework for making specific decisions for consensus;
- to provide opportunity to examine disagreements and simulate discussion and opinion;
- to offer opportunity to change criteria and modify judgments;
- to force one to face the problem holistically;
- to offer an actual measurement system and to enable one to estimate relative magnitudes and derive ratio scale priorities accurately;
- to organize, prioritize, and synthesize complexity within a rational framework;
- to interpret experience in a relative way without reliance on a black box technique like a utility function, and;
- to help deal with conflicts in perception and judgment.

The AHP uses the following three fundamental ideas: order, proportionality, and ratio scales (Saaty, 1996). The order of the characteristics in the hierarchy establishes harmony and synchrony among the parts. The proportionality phenomenon explains the fact that there is a ratio relation among the parts. The process of the AHP, highlighted by Drake (1998), consists of the following four steps:

1. Decide upon the criteria for selection;
2. Rate the relative importance of these criteria using pair-wise comparisons;
3. Rate each potential choice relative to others on the selection criterion--this is achieved by performing comparisons of the choices; and
4. Combine ratings in the 2nd and 3rd steps in order to obtain an overall relative rating for each potential choice.

The use of the AHP generally serves two purposes: (1) assigning weights to a set of predetermined criteria or measures; and (2) prioritizing or ranking elements to identify the key elements (Cheng and Li 2002).

The ratio scales are used to capture and synthesize the relations inherent in the order. The methodology captures priorities from paired comparison judgments of the decision elements with respect to each parent criteria. Paired comparison judgments are arranged in a matrix. The priorities are then derived from the matrix as its principal eigenvector, which defines a ratio scale.

Table 2.1: Fundamental Scale of Measurement for AHP

Numerical Value	Equivalent interpretation	Explanation
1	Equally important or preferred	Two elements contribute equally to the property
3	Moderately more important or preferred over another	One element slightly favored over another
5	Strongly more important or preferred	One element is strongly favored over another
7	Very strongly more important or preferred	A criterion is strongly favored and its dominance is demonstrated in practice
9	Extremely more important or preferred	The evidence favoring one element over another is of the highest possible order of affirmation
2, 4, 6, 8	The numbers are intermediate values and their evaluation is based on the approximate strengths of the upper and lower values	Compromise is needed between the two compared judgments.
Reciprocals	The reciprocals are used for inverse comparisons which express the opposite judgment.	If activity i* has one of the preceding numbers assigned to it when compared with activity j*, then j* has the reciprocal value when compared with i*.

Source: The Analytic Hierarchy Process, Thomas L. Saaty (1980)

Thus, the eigenvector is an intrinsic concept of a prioritization process (Saaty, 1990), which allows for the measurement of inconsistency in judgment. Pair wise assessment of the decision alternatives is a scientific approach in which verbal expressions (e.g., equal importance, moderate importance, strong or essential importance, very strong importance, and extreme importance) are used in concert with a fundamental scale of absolute numbers (Table 2.1) corresponding to the linguistic (verbal) comparison (Saaty, 1996).

The criteria are compared in pairs, with one criterion awarded a score reflecting its relationship to the other criterion in the pair. For example, if criterion X is judged to be very strongly more important than criterion Y, a score of seven is given. A fundamental concept in evaluating the judgments is that the smaller or lesser element serves as the unit and the larger or greater one is estimated as a multiple of that unit. Hence, judgments that reflect ideas, feelings, and emotions are represented with meaningful numbers (Saaty, 1980). Ratios are used to judge the importance of each criterion relative to the other in pairs. The pair-wise comparison data are arranged in the form of a matrix, A, as follows:

$$A = \begin{bmatrix} a_{11} & a_{12} & . & . & a_{1n} \\ a_{21} & a_{22} & . & . & a_{2n} \\ . & . & . & . & . \\ . & . & . & . & . \\ a_{n1} & a_{n2} & . & . & a_{nn} \end{bmatrix}$$

Where:

A = the pair-wise comparison matrix;

a_{ij} = relative importance rating of two objectives

ij = value in the ith row and jth column in the comparison matrix, A

If the judgments made are consistent, (Saaty, 1980), the AHP provides two ways to achieve the answer:

1. By adding any column and dividing each entry by the total. Hence, by normalizing the column, any column renders the same result. This provides a quick test of consistency, if all of the columns give the same answer.
2. By adding the rows and normalizing the result.

Conversely, when the judgments are inconsistent two solution sets are illustrated by Saaty (1996) to provide the answer:

- By normalizing each column, forming row sums, then normalizing the result, and
- By raising the matrix to powers and normalizing its row sums.

The data of pair-wise comparison are then translated into the absolute importance weights signifying priority order. The relative importance of the criteria relative to the related infrastructure category is derived from these ratios.

The priority factors or weights, W, are computed as the principal right eigenvector of the matrix A, such that:

$$AW = \lambda_{max} W \quad \text{..... (2.1)}$$

Or

$$\sum_{j=1}^{n} a_{ij} W_j = \lambda_{max} W_i ; \quad \text{..... (2.2)}$$

Where:

W_j = the priority factor or weight of alternative j

W_i = priority vector for alternatives i

hence

$$W_i = \frac{\sum_{j=1}^{n} a_{ij} W_j}{\lambda_{max}} \quad \text{..... (2.3)}$$

For all $i, j = 1, 2, \ldots\ldots\ldots, n$

The vector sum of the absolute values of the weights is unity, as shown in Equation (2.4):

$$\sum_{i=1}^{n} W_k = 1 \quad \text{..... (2.4)}$$

Where:

W_i = the vector of absolute values of importance weights;

a_{ij} = the importance of alternative i over alternative j;

λ_{max} = the highest eigen value (or principal eigen value) in matrix **A**;

n = the number of derived scale values.

Consistency Ratio. The eigenvector method also yields a measure for inconsistency made in pair-wise comparison. As shown by Saaty, λ_{max} is greater than or equal to n for positive definite reciprocal matrices and is equal to n if and only if A is a consistent matrix.

A consistency ratio is generated for each prioritized scale upon completion of the pair-wise comparisons. This ratio is then used to determine the consistency of the judgments. The consistency ratio is defined as the consistency index for a particular set of judgments divided by the average random index (Saaty, 1982). Perfectly consistent judgments would be represented by a consistency index of zero, the same as the consistency ratio. In contrast, the consistency ratio, being equal to or greater than 0.1, indicates inconsistency of the judgments. Hence, λ_{max}-n provides a useful measure of the degree of inconsistecy. The consistency index (C.I.) is measured (Saaty, 1996) from normalizing this measure by the size of the matrix as:

$$C.I = \frac{\lambda_{\max} - n}{n-1} \quad \text{..... (2.5)}$$

For each size of matrix n (Harker, 1980), random matrices are generated and their mean C.I. values, called random indices (R.I.s), are computed (see Table 2.2).

Table 2.2: Random Inconsistency Index (R.I)

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
R.I	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

Source: P.T. Harker (1980).

Using these values, the consistency ratio (C.R.) is defined as:

$$C.I/R.I \quad \text{..... (2.6)}$$

A value of C.R. ≤ 0.1 is considered acceptable; larger values require the decision-maker to reduce the inconsistencies by revising the judgments.

There are three basic principles upon which AHP is based: decomposition, comparative judgments, and hierarchical composition or synthesis of priorities (Forman and Selly, 2001). AHP has become one of the essential multi-criteria decision-making methods used by both management practitioners and academics.

Application. Ever since its development in the 1970s by Saaty (1980, 1982), the AHP has found extensive applications in social studies, economics, and in various fields of science and technology. The extensive applicability of the methodology in a variety of decision-making environments has been documented by various authors (Golden et al., 1989; Zahedi, 1986; Vargas and Zahedi, 1993; Wasil and Golden, 1991). According to Naidong and Minxue (1992) AHP's wide applicability is due to its ability to cope with complicated problems which are difficult to analyze quantitatively, as well as its potential as an analytic method. The methodology works comparatively well in arranging and generalizing subjective human judgments and then making high quality objective descriptions (Yager et al., 1987). Generally, the AHP has become known as an essential tool for practicing managers and academic researchers conducting research for business decisions and examining management theories, respectively.

One method to rationalize multiple objectives and therefore keep them to a manageable number may be based on the approach of Kepner and Tregoe (1965, 1981). Moreover, a good approach for prioritizing or ranking "wants" is to use paired comparisons. An example of this approach is the Analytic Network Process (ANP) (Saaty and Vargas, 1982), a method which uses primarily qualitative judgments to measure the strength of interactions in a complex environment. An advantage of this approach (Thope, 2000) is that qualitative variables can be included in the analysis. In addition, variables can be arranged in a hierarchy, enabling the contribution of a number of variables to be expressed in terms of a much smaller set of weighted objectives. Dikmen and Birgonul (2006) have proposed a methodology for risk and opportunity assessment of international projects which uses an AHP for the calculation of risk and opportunity ratings. Ranking of project options is made according to the opportunity and risk ratings that are calculated using the proposed methodology based on the judgments of company

professionals. Lam et al. (2007) used the quantitative decision-making technique AHP to derive prioritized scales for constructability factors as well as the relative contribution of common construction systems in a building superstructure. Lam's objective had been to facilitate efficient and safe construction in the busy urban environment of Hong Kong.

In general, building and construction industries extensively use the AHP methodology. Specifically, this application tool has been widely applied in facility management and benchmarking (Gilleard and Wong, 2004), asset management (Tran et al., 2003), selection of demolition techniques (Abdullah and Anumba, 2002), priority setting for home purchase (Wong and Wu, 2002), dispute resolution (Cheung et al., 2002; Vegas, 1990), procurement selection (Khalil 2002; Cheung et al., 2001), contractor selection (Mahdi et al., 2002; Fong and Choi, 2000), project management (Al-Harbi et al., 2001), maintenance management (Shen et al., 1998); and analyses of risks (Dey, 2003; Dikmen and Birgonul, 2006).

Limitations of AHP and its Application in Research. Empirical work on the AHP indicates that different methods of designing the hierarchies of the same problem may lead to contrasting results (Adelmann et al., 1986; Stillwell et al., 1987). The structure of the hierarchy must follow the perception of the individual (or group) when there is no possible alternative (Hurtwich, 1999). Another limitation has to do with different options of aggregating responses from experts. Either few or many can participate in the AHP. The aggregation of weights can be achieved either compensatorially or non-compensatorially among the group carrying out the performance rating (Arrington et al., 1982). The question has to do with when these ratings should be merged. They can be merged with a group discussion to arrive at an aggregate judgment or, alternatively, each individual can carryout his or her rating independently. AHP then calculates the local and global priorities for each individual, and priorities are aggregated by geometric means.

Another limitation of AHP is that the procedures of pair-wise comparisons are time consuming $[n\ (n-1)\ j]$ and must be conducted on a per level basis.

Where

n = number of comparisons; and

j = number of criteria.

Some experts may find it somewhat tedious to go through such a formidable amount of pair-wise comparisons (Lockett et al., 1986). In some situations, experts may begin to reflect too excessively on the problem (Hurtwich, 1999). Related to this critique is the argument that after a certain time, experts may loose interest in being interviewed. To address this Hurtwich has recommended that simpler multiple criteria methods be applied.

In most usages of the AHP, more complexity is achieved when different groups or peers carry out their ratings of different levels. For example, key actors in management judge the importance of criteria, and other groups (like community representatives), judge the importance of the alternatives. Which approach is to be adopted is mainly a function of the type, purpose, and scope of the specific evaluation study (Hurtwich, 1999). These limitation examples illustrate that the AHP can be a valuable decision-making tool within the construction industry, but only with proper and cautious usage. Municipalities must judge, appraise, or determine the worth, value, or quality of their capacity to sustain rehabilitated or reconstructed infrastructure facilities. This can be adequately addressed through assessment in terms of municipality effectiveness, efficiency, impact created, social conditions, etc.

For the purpose of this work we presume "effectiveness" to mean the degree to which postwar reconstruction projects are embraced by a municipality. "Efficiency" refers to willingness of citizens to embrace cost-effective programs for the long-term sustainability of replaced facilities. "Impact" is the long-term effects of reconstructed or rehabilitated facilities on improving the quality of life of the citizenry. "Relevance" refers to the appropriateness and importance of goals and objectives in relation to decisions affecting the allocation of facilities for reconstruction. A detailed analysis of the above concerns requires an in-depth understanding and assessment of the criteria in any infrastructure category.

This research study utilizes the AHP in order to derive weights for criteria in a given infrastructure category. The seven infrastructure categories indicated in earlier chapters were assessed based on a municipality's ability to sustain reconstructed infrastructure facilities. These capabilities vary by category within municipalities. The use of AHP has underscored the fact that criteria in an infrastructure category (e.g., in

education the economic condition of municipality, ethnicity and heterogeneity of local citizens; affordability of service; influence of the education ministry; etc.) do not necessarily represent equal ratings of importance (referred to here as weight). Rather, they are assessed according to their contribution to the sustainable infrastructure category under discussion. An AHP is used to develop the relative weights, $\overline{w}_i$, of infrastructure categories with respect to their criteria evaluation in each municipality. The maximum number of criteria for pair-wise assessment of relative importance in the categories is nine. This has proved to be a reasonable enough number for effective comparison of each criterion relative to the others and has not resulted in being tedious for experts carrying out the comparison.

The justification for using AHP was based on several reasons. First, the AHP helps capture both subjective and objective evaluation measures, providing a useful mechanism for checking the consistency of evaluation measures and alternatives suggested by the evaluation team(s), thus reducing bias in decision making. Second. AHP allows organizations to minimize common pitfalls of decision making processes, such as lack of focus, planning, participation, or ownership, which ultimately are costly distractions that can prevent teams from making the right choice. Thirdly, AHP has proved to be very useful when the decision-making process is complex, as is the case for postwar situations. Indeed, when the decision cycle involves a variety of multiple criteria where rating is based on a multiple-value choice, AHP splits the overall problem into as many evaluations of lesser importance, while simultaneously keeping their part in the global decision.

2.3.2 Hamming Distance

There exists a wide variety of methods for distance measure, including the Hamming distance, the Euclidean interval-vector distance, the interval-difference distance measure of Coyle and Shmulevich, the swap distance, and the chronotonic distance measures of Gustafson and Hofmann-Engl. The question of which measure to use in a particular application has received much attention in all areas that are concerned with the comparison of sequences (Toussaint, 2006). One rationale discussed in Kruskal (1983) is the application of the universal post hoc justification process. "If we use any

particular definition for distance, and find that this kind of distance supplies information we want, that 'it works' when we check its performance, then the satisfactory performance justifies the definition" (p. 3). This rationale implies the comparison of several measures to determine which works best for the intended application. Dissimilarity and similarity measures were compared on the basis of how much insight they provided about structural inter-relationships that existed within families of infrastructure facilities. Hence, since a measure of similarity was preferred for this research, the Hamming distance proved to be the most efficient.

The Hamming Distance is named after Richard Hamming, who introduced it in his seminal paper about *error-detecting and error-correcting codes* (1950). It is used in telecommunications to count the number of flipped bits in a fixed-length binary word as an estimate of error, and therefore is sometimes called the signal distance. Hamming Distance is defined by Random House Webster's dictionary (1991) as "a measure of the difference between two binary sequences of equal length; in particular, the number of bits which differ between the sequences." As a result, the Hamming Distance between two codes is the number of symbols that disagree. For example, in terms of bit patterns, the Hamming Distance is a count of difference in bits between the two patterns.

More generally, if two ordered lists of items are compared, the Hamming Distance is the number of items which fail to identically agree. With respect to information theory, the Hamming Distance is the number of positions in two strings of equal length for which the corresponding elements are different. This measure records the number of substitutions required to change one into the other: (i.e., given n elements, decide whether any two of them have a "small" Hamming Distance).

For a fixed length, n, the Hamming Distance is a metric on the vector space of the words of that length as it obviously fulfills the conditions of non-negativity, identity of indiscernible and symmetry, and it can be shown easily by complete induction that it satisfies the triangle inequality as well. The Hamming Distance between two words a and b can also be seen as the Hamming weight of $a-b$ for an appropriate choice of operator.

For binary strings a and b the Hamming Distance is equivalent to the number of 1s in a or b. The metric space of length-n binary strings, with the Hamming Distance, is known as the *Hamming cube*; it is equivalent as a metric space to the set of distances

between vertices in a hypercube graph. One can also view a binary string of length n as a vector in $\mathbb{R}^n$ by treating each symbol in the string as a real coordinate; with this embedding, the strings form the vertices of an n-dimensional hypercube, and the Hamming Distance of the strings is equivalent to the Manhattan distance between the vertices.

Adopting these scenarios in the research, Hamming Distance is used as the difference in values of the quality of life criteria within a category: that is, the gap between the ideal standard or baseline (based on sub-Saharan values), and the current status of the respective municipality (based on present values) whose details are fully discussed in the methodology chapter.

Application of Hamming Distance. Hamming Distance is not a widely known terminology in the field of infrastructure or civil engineering. In fact, it has been predominantly used in information technology.

Ramsey (2004) has computed a fuzzy search by the maximum Hamming Distance that can separate similar strings or some equivalent phenomena. The author used the analogy of the Hamming Distance between trees, where the Hamming Distance between the strings is the distance between the trees. The trick in using this technique is to define the trees appropriately for the problem (Ramsey, 2004). Ros and Sutton (2004) based their work on code compression effect. The encoding scheme presented was based on the appropriate selection of dictionary vectors such that all program vectors were at most a specified Hamming Distance from a dictionary vector. The authors had created a benchmark to be compressed. This benchmark is read as one 32-bit, which was at most a set Hamming Distance from any one of the reduced dictionary vectors. The authors had used what they referred to as maximum span selection, which is the total number of other dictionary vectors that are within a set maximum Hamming Distance. The vector that spans the most other vectors is chosen and placed in the reduced dictionary. The compression scheme, according to Ross and Sutton, uses Hamming Distances to support the resulting small Hamming Distance of the large portion of the program code by determining which dictionary combination methods are optimal. Based on this, the authors selected all dictionary vectors such that all program vectors were at most a specified maximum Hamming Distance from a dictionary vector. Manku et al. (2007) has

presented a technique which focuses on near detection of page web and document clustering. Hamming Distance is computed on the set of fingerprints generated by SimHash. The authors showed that a distance of 3 is sufficient for near document detection. Hamming Distance in this context means that the authors searched for fingerprints that differed from those submitted for at most *n* bytes.

The use of Hamming Distance and Applicability in Research. The author has not uncovered any work in the construction industry which uses the Hamming Distance technique. Attention to the use of this technique has been directed at the information technology field as illustrated in the examples in the preceding sections. The variance in characteristics of municipalities based on a measure of the extent to which current criteria values reflective of the infrastructure categories deviate from those for a normal society: the Sub-Saharan African values in this case. Knowledge of the size of the gap in a municipality relative to the other municipalities is a desirable necessity. It is necessary because it provides an indication of the quality of life of people in the different municipalities, with regard to indicators such as education, health, water and sanitation security, transportation, social activities, etc.

Donors in particular would find these values useful in order to have an indication of area (which category) and level (at what scale or degree) of involvement. A methodology which is capable of compressively obtaining or estimating the deviation (gap) or lacking has become necessary for postwar situations in which indicators of quality of life criteria fall to very low levels. The Hamming Distance approach as already discussed has presented a possible means to obtaining accurate estimators for the ranking of municipalities based on quality of life indicators through infrastructure criteria categories comparative assessment.

2.3.3 Semantic Differential

As advanced by Osgood (1957), the semantic differential technique is an efficient and reliable instrument for measuring perceptions or attitudes. Osgood defines semantic differential as scales differentiated attitudes based on one's understanding of concepts or words. This technique can be conceived of as a survey instrument in which respondents are asked to rate their opinion on a linear scale between two opposite pairs of words, a

notion Osgood refers to as the measurement of meanings. The framework provides an approach for plotting the psychological distance between words by mapping one's connotations of the words. The scale's differentiated attitudes based on the connotations of words are referred to as "semantic differential."

In adopting the methodology, subjects are given a word, and rating of that word is carried out with a variety of opposing adjectives along a seven point scale. Osgood has contended that the adjectives selected must be evaluative in nature. Evaluative scales such as *good-bad, fair-unfair* and *valuable-worthless* can be used in some instances, and institutionally non-evaluative scales such as *fast-slow, stable-changeable* and *heavy-light* may also be put into use. It seems reasonable to identify attitude, as it is ordinarily conceived in both lay and scientific language with the evaluative dimension of the total semantic space (Osgood, 1957). Semantic differential provides one method to gain a visual understanding of perceptions and attitudes. Ratings are made on a series of ordered categories with the various values being assigned to different categories. Numbers or adjectives can be used for the values. Concepts are rated on several seven-point bipolar adjective scales. The concept of bipolar means that the middle category reflects equal amounts of dominance and submissiveness, as shown in Figure 2.1.

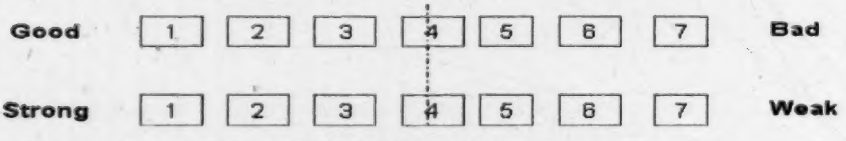

Figure 2.1: Semantic Differential Bipolar Scale

Concepts such as "building" are presented along with a variety of adjectives with which to describe them. The adjectives are presented at either end of a seven-point scale ranging, for example, from "good to bad" or from "strong to weak." In this way, one is able to draw or map connotations for a given word. Assigning a value along a 7-point scale (Figure 2.1) between opposing evaluative adjectives, the meaning of a concept is made by its allocation to a point in the multidimensional semantic space. Usually the position marked 4 is labeled "neutral," the 3 and 5 positions are labeled "slightly," the 2 and 6 positions "quite," and the 1 and 7 positions "extremely." The

scale measures directionality (e.g., good versus bad) and also intensity (e.g., slightly through extreme).

In one of the largest research projects ever conducted in the social sciences, Osgood, May, and Miron (1975) found evidence for the cross-cultural universality of the evaluation (E), potency (P), and activity (A) dimensions (EPA dimensions) of affective response. Semantic scaling on EPA dimensions facilitates valid and reliable measures of affective meaning of sentiments (Osgood, 1962; Osgood et al., 1975). The EPA dimensions are valid and reliable measures of affective meanings that explain large portions of variance in sentiments.

These three concepts, according to Osgood, transcend language and culture so as to reasonably generate an evaluation of the semantic space in any given environment. These concepts are factored into the types of adjectives chosen for judgments:

- Evaluative scales: These consist of evaluation statements such as *good-bad, hot-cold, smooth-rough.*
- Power scales: These measure power and potency of judgmental connotation such as *strong-weak.*
- Activity scales: These measure judgments such as *active-passive* or *tense-relaxed.*

In the case of Sierra Leone reconstruction, the complexity of the situation has led the researcher to use a combination of the three scales to measure the "scale of destruction" and to measure and collate the "influencing factors." The foundational work of Osgood has established the principle of affective representation and the three dimensional semantic scaling of affective meaning as a cultural universal. It has also demonstrated that ratings on these scales are highly discriminating measures of culturally-specific meanings. Both properties--the cultural universality of the instrument and the cultural particularity of the measurements--are core prerequisites for valid cross-cultural comparisons (Schneider, 2002).

Applications of Semantic Differential Technique. Al-Momani (2003) has addressed problems of surplus migration and the influence of rising educational

attainment of Jordanian citizens based on types of accommodation required. The author's main objective was to build housing units for limited-income groups. To explore this, Al-Momani analyzed the choice that best satisfied customers' need using the semantic differential technique. Questionnaires were used which contained 45 attitudes for housing units constructed in several cities.

Veneklasen et al. (1978) have conducted a study to determine the reliability and validity of using 100-mm bipolar semantic scales to establish an "ideal" which, according to the authors, could be used as a standard for subjectively evaluating facilities. The methodology permits all facilities to be evaluated by looking at the difference between the profiles of ratings of existing and ideal facilities. In order to provide a meaningful evaluation, the authors deduced that the ideal scales must be paired with some dependent measure, such as existing scales. Without such a basis for comparison, Veneklasen et al. inferred that there was very little differentiation between ideal ratings of various objects.

Pfeiffer-Rudy's (2005) analysis of architectural education using semantic differential technique was based on the work of Alexander (1979). Both authors believed that technical information on buildings can only serve to inform the building design process effectively if communicated on the basis of comparisons which allow for the architect to relate them qualitatively. This reasoning is supported by Pfeiffer-Rudy (2003) that a case-based, detailed knowledge must be tied to the kinds of semantic differential that enable an interpretive comparison of competing options, such as "better/worse," "efficient/inefficient," "light/heavy," and so on. Rudy referred to these options as polarity profiles that describe the experimental impact of buildings. The author used 46 psychological-architectural polarities, which described the perceived qualities of 300 buildings whose spans were reviewed or assessed based on semantically opposing terms. Such multi-dimensional ontology maps should serve to point up the information needs that arise in the course of individual building design paths so that they may be met more effectively by the projected decision-support system.

Rothman (1988) administered a 192-item science-related semantic differential instrument to 338 freshman physics and chemistry students at The State University of New York. He concluded that the method allowed an investigator to analyze the ways in which judgments varied as a result of the scale adopted. The author also took into

account the evaluation of overall attitude toward the specific areas of interest using a relatively small array of numbers.

Evans (1978) has assessed the difference between the perceived service offerings of two companies whose services were virtually identical. To differentiate one product or service from that of the competitor, Evans noted that it is vital to determine where services are perceived to be different: e.g., looking for a "crack in the wall" in order to differentiate services (Evans, 1978). Using a portfolio of services which defined company operations and activities, Evans used the semantic differential scale to carry out a discriminate analysis of the two companies in order to determine the difference between perceived service offerings.

The use of Semantic Differential and Applicability in Research. The stakeholders in postwar reconstruction are many: donors, NGOs (both local and international), government, and the citizenry. The issues associated with these different groups are complex and have become a primary problem facing postwar developing countries. A lack of clear understanding, proper analysis, and evaluation of these problems results in misguided policy formulation and poses difficult challenges to any successful postwar reconstruction initiative.

The broad range of stakeholders calls for an analysis of the attitudes attributed to these key stakeholders in terms of how they affect the reconstruction process. The factors that influence people's choice for selection of the infrastructure facilities in any of the categories that best satisfy the needs of the people as well as the donors, government, and bilateral institutions are to be identified. Behind this diversity of stakeholders, attitudes reflect many things about the individuals within the various stakeholder categories (e.g., requirements and mandates of donors; how municipalities are valued; social characteristics of citizens; options in infrastructure facilities; varied and conflicting priorities; habits and interactions within reconstruction stakeholders). This work closely examines these factors, and this endeavor constitutes an underlying theme behind the research. The significant influence of the attributes influencing the selection and allocation of infrastructure facilities to municipalities for reconstruction or rehabilitation is carefully assessed. The semantic differential technique has been well

utilized and explored in professional social science (Al-Momani, 2003). In this work, it is employed to measure stakeholder attitudes in their respective domains (donor, government, NGOs, etc.). Their influence on the reconstruction process is assessed and their impact on several aspects of reconstruction (in the respective infrastructure categories) is measured.

2.3.4 Fuzzy Set Theory and Logic

Fuzzy logic is a superset of conventional (Boolean) logic which has been extended to handle the concept of "partial truth." Truth values lie somewhere between "completely true" and "completely false" (Zadeh, 1965). As its name suggests, the logic's underlying modes of reasoning are approximate rather than exact. Pioneering work in fuzzy logic was done by Zadeh (Zimmerman and Zysno, 1983), who built on the fact that most modes of human reasoning, and especially common sense reasoning, are approximate in nature. Fuzzy logic was first introduced by Zadeh (1965), who suggested that a fuzzy set is a class of objects with a continuum of levels or grades of membership. The set is characterized by a membership (characteristic) function which assigns a grade of membership ranging between zero and one to each object. Zimmerman and Zysno (Romaniuk and Hall, 1992), and others (Chen and Chiou, 1999; Gambetta, 1992) have applied fuzzy set theory to formalize the credit rating processes which banks conduct. Zimmerman and Zysno (1983) report on subcontractor evaluation as a similar process, and it is therefore likely that fuzzy sets can also be applicable in this context. However, the authors have identified three major problems with applying fuzzy logic to an e-commerce rating system:

Choice of Operators – One problem with the fuzzy set approach is that its success depends on what operators are used when aggregating the information, a choice which is often arbitrary.

Converting Input to fuzzy numbers – Another difficulty of applying fuzzy sets is capturing input data and converting it to a fuzzy membership function. For example, does the fact that a devastated municipality has already been selected and provided for reconstruction in prior projects mean that it should be assigned a membership function for the set "very good" (0.7)?

Integration of Credibility – There is no natural way of integrating the impact of source credibility into a fuzzy set rating system. One solution would be to make the ratings fuzzier the less credible the source is. But again, this solution would necessitate arbitrary judgments. The designer would have to choose what operator to use to "fuzzify" the ratings depending on the credibility of the source. It is not yet evident how these three problems can be overcome in a fuzzy set rating system. Furthermore, by moving from real to fuzzy numbers, the system reaches another level of complexity. This will possibly lead to more accurate results, but may also result in a system where output becomes more difficult to interpret and validate.

Fuzzy logic is all about approximate reasoning (Martin Hellmann, 2001). A fuzzy preposition includes a possibility distribution over a universe of discourse (D. Dubois and H.M. Prade, 1980). Fuzzy logic maps every proposition into [0, 1], where there is a subjective concept of "degree of truth" associated with each selected mapping. It deals with the degree of truth of a fuzzy preposition, which can be conditional, qualified, (or both), or simple. The degree of preposition is interpreted as the degree of membership of the element to the fuzzy set. The aim is to present a problem-solving technique that integrates both expert judgments and a decision-aiding model in order to identify the planning sequence for selection of municipalities for reconstruction. Stating that a municipality is "better" or "worse" than the other based on criteria values which cannot be distinctly differentiated among municipalities can be analyzed fully with the help of the fuzzy logic methodology.

This approach is based entirely on reasoning and decisions, which are subjective and practically constitute mechanisms of the logic. This leads to the concept of fuzziness, which assigns a fundamental importance to the concept of "degree" or level of grasping reality (Gil-Aluja, 2004). Fuzziness was first proposed by Gerado Xexéo (2004) as a faster and cheaper method to model human reasoning in order to control highly complex situations. It offers a means of representing uncertainty, possibility, and approximation. This concept of belonging, as stated by Zadeh (1965), provides a natural way of dealing with problems in which the source of imprecision is the absence of sharply defined criteria of class membership. From the classical set theory, elements either belong to or

do not belong to a set: "the Law of Excluded Middle." Fuzzy logic is essentially about breaking this law.

A fuzzy set can be defined as a set, A, over a universe of discourse, X, (a finite or infinite interval within which the fuzzy set can take a value) is a set of pairs

$$A = \{\mu_A(x) : x \in X,\ \mu_A(x) \in [0,1] \in \Re\}$$

Where $\mu_A(x)=0$ is called the membership degree of the element, x, to the fuzzy set, A. This degree ranges between the extremes **0** and **1** of the dominion of real numbers:

- $\mu_A(x)=0$ indicates that x in no way belongs to the fuzzy set, A.
- $\mu_A(x)=1$ indicates that x completely belongs to the fuzzy set, A.

In some cases, instead of giving an exhaustive list of all the pairs that make up the set (discreet values), a definition is given for the function , $\mu_A(x)$, referring to it as a characteristic function or membership function.

Fuzzy set A, therefore, uses a membership function, μ_A, which extends in the range of [0, 1]:

$$\mu_A : U \rightarrow [0,1]$$

Where:

U = The sample space of the set of all possible outcomes, μ_A, within the range [0,1].

The function, μ_A, is designed case-by-case to represent a degree of membership.

Typical fuzzy sets represent imprecise concepts such as "minor destruction" and "moderate destruction." Functions with specific shapes are highly preferred, such as triangular, trapezoidal, s-shaped and gauss functions (Klir and Yuan, 1995) and are used to save computational time. In general, the trapezoid function adapts quite well to the definition of any concept, with the advantage that it is easy to define, easy to represent, and simple to calculate. Also, the use of a more complex function does not give increased precision, as we must keep in mind that we are defining a fuzzy concept. The approach in defining these functions is linguistic in nature (Zadeh 1965). As explained by Zadeh, it is based on two main concepts: the linguistic variable and the linguistic term. A linguistic

variable represents a concept that is measurable in some way, either objectively or subjectively, such as destruction level. Linguistic variables are characteristics of an object or situation. The linguistic terms rate the characteristic denoted by one linguistic variable. Moreover, a linguistic term is a fuzzy set and the linguistic variable defines its domain. Geraldo Xexéo (2004) summarizes an adequate representation of fuzzy sets, involving a basic understanding of five real conceptual symbols:

1. the set of elements, $\theta \in \Theta$, as in "facility" from "group of infrastructure facilities";

2. the linguistic variable, V, which is labeled for one of the attributes of the elements, $\theta \in \Theta$, as in "destruction level" of "facility";

3. the linguistic term, A, which is an adjective or adverb describing the linguistic variable and a subjective measure of V, as in "minor" describing "destruction level";

4. a referential set, $X \subset \Re$, which is a measurable numerical interval for the particular attribute, V, as in "[1,7] bipolar scale" for "destruction level"; and

5. a subjective numerical attribute, $\mu_A(\theta)$, of the membership value: i.e., the membership degree of the element, θ, labeled by the linguistic variable, V, as described by A.

Hence, for a linguistic variable V, there will be a measurement process resulting in a measured value, $m_v \in \Re$, for each element, $\theta \in \Theta$. To interpret this measurement, subjective notions are defined as linguistic terms. $A_0, A_1, A_2, ..., A_n$ and their membership functions $\mu_0(x), \mu_1(x), \mu_2(x), ..., \mu_n(x)$, with domain $\Re$ and range [0,1]. Applying μ_i and m_v, the degree of membership for element θ in set A_i are obtained. This defines the degree of accomplishment of the linguistic term, A_i, when it is used to express a subjective measurement of V. .

Fuzzy logic is a way of representing and modeling uncertainty and imprecision. The basic premise is that most (all) applications in the general area of modeling decision making have to cope with imprecision in data, knowledge, rules, etc. Fuzzy logic provides a way of not ignoring this imprecision but rather using it to make better decisions. Therefore, the use of fuzzy logic for creating decision-support and expert

systems has grown in popularity among management and financial decision-modeling experts. Still others are putting it to work in pattern recognition, economics, data analysis, and other areas that involve a high level of uncertainty, complexity, or nonlinearity. There are presently numerous applications in the construction industry that incorporate fuzzy logic concepts.

Two main features of fuzzy logic are interesting in the application to postwar situations: (1) the flexibility of fuzzy sets to represent different types of uncertain information; and (2) the availability of different combination operators to perform the data fusion step. Some of these facets could not be adequately modeled by a probability distribution; in particular, no probability distribution can represent the imprecision or the unreliability in the data or information.

For this research, the application of fuzzy logic to postwar reconstruction created opportunities to examine:

- contradictions and inconsistencies embedded in postwar situations;
- issues that have been repressed under critical postwar dynamics; and
- that which is concealed and beyond observed social phenomena.

Fuzzy logic was also suited to this study because of its ability to:

- deal with vague, ambiguous, and uncertain qualitative ideas and judgments;
- concentrate on paradoxical and enigmatic aspects of decision situations;
- focus on the margins of any decision making 'space'; and
- appreciate the uniqueness in any decision making act.

A variety of approaches are also available which can be classified into the following categories:

♦ *Horizontal approach.* Adopts the use of frequencies from a group of expert from which a distinction is made on the numbers of those answering yes and no to a specific question about the belongingness to a particular set;

♦ *Direct estimation.* Involves asking experts in the field to grade an event on a predefined

scale;

- *Vertical approach*. Involves asking experts to identify plausible intervals;
- *Rank ordering* (Saaty, 1980). Involves pair-wise comparison in the identification of experts' level of preference of objects;
- *Problem Specification*. Requires a numerical function that should be approximate. The error is defined as a fuzzy set that measures the quality of the approximation.
- *Optimization of Parameters*. The shape of a fuzzy set depends on some parameters.
- *Fuzzy Clustering*. This method is based on clustering the objects of the universe in overlapping groups whose levels of membership to each group are considered as fuzzy degrees.

In conclusion, fuzzy logic provided an alternative way of understanding uncertainty. From this new way of understanding can be derived innovative approaches and strategies for working with the uncertainty that so often characterizes postwar situations.

2.3.5 Fuzzy Modeling

If/then rules offer a convenient format for expressing pieces of knowledge. But it is just a format which can cover different intended semantics and uses (Dubois and Prade, 1992). Modeling with fuzzy based rules involves two distinct approaches. The first, which comprised four stages, is the identification of the surface structure. This initial stage involves:

1.Selection of relevant input and output variables

2.Choosing a specific type of fuzzy interference system

3.Determining the number of linguistic terms associated with each input and output variable; and

4.Designing a collection of if-then rules.

The four stages provide the systematic approach to obtaining a rule base that describes the behavior of the situation that is to be analyzed using linguistic terms.

The second approach to the modeling process involves assigning meanings of the linguistic terms. The process is referred to as "identification of deep structure." It also determines the membership functions of each linguistic term. Three stages are involved in the identification of deep structure:

1. Choosing an appropriate family of parameterized membership functions;
2. Interviewing experts who are familiar with target systems to determine the parameters of the membership functions;
3. As detailed in Jang et al. (1997), refining the parameters in the membership functions.

Depending on their interpretation, rules have to be represented and processed in a specific way at the inference level. The standard if-then representations are used. Its basis can be written in the form:

$$\text{IF } a_1 \textit{ AND } a_2 \ldots\ldots\ldots\ldots \textit{AND } a_n \textit{ THEN } b,$$

Where a_i, $1 \le i \le n$ and b are fuzzy prepositions. Each rule represents some reasonable assumption about the actions (output values) that should be taken in the case of that state of the system (input values). The inputs are combined logically using the AND operator to produce output response values for all expected inputs. The function of logic operators is to determine the logical outcome of combining multiple membership values. The AND logic operator is equivalent to the fuzzy set intersection operation. It is the minimum membership value of the fuzzy sets being combined. In MIN inferencing, the output membership function is clipped off at a height corresponding to the rule premise's computed degree of truth (Zadeh, 1974). This corresponds to the traditional interpretation of the fuzzy logic AND operation. Actually, the connective "and" can be implemented as a fuzzy conjunction, which is generally associated with triangular norms. The inputs can be logically combined using the AND operator to produce output response values for all expected inputs.

The basic Zadeh OR operator is equivalent to the fuzzy set union operation. It is the maximum value of the degrees of membership of each fuzzy set being combined. There is no product version of the OR operator, but there are compensatory operators which are along the continuum between the extremes of AND and OR. In MAX

composition, the combined output fuzzy subset is constructed by taking the point-wise maximum over all the fuzzy subsets assigned to the output variable by the inference rule. The connectives "or" is usually implemented as a function disjunction, which is in general associated with triangular conorms.

When do you use one operator set in place of another? This depends entirely on your personal style and system requirements (Brubaker, 1995).

The active conclusions are then combined into a logical sum for each membership function. A firing strength for each output membership function is computed to unify the most viable municipalities. Both input and output are described by fuzzy sets.

In integrating, two steps are performed:

1. calculation of the value of the consequent of each fired rule; and
2. calculation of a consolidated result.

To execute step 1, the maximum - minimum algebraic product can be used resulting to the fuzzy reasoning shown in Figure 2.2.

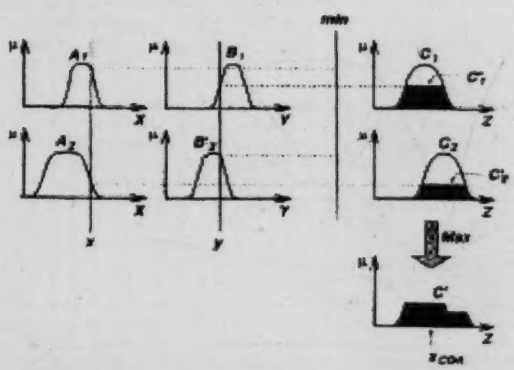

Figure 2.2: The Mamdani Fuzzy Interference System Using Min and Max
Source: Jang et al. (1997)

The t-norm minimum operator is identical to the fuzzy AND operator and the s-norm maximum operator is identical to the fuzzy OR operator. Both s-norms and t-norms establish generic models respectively for the operations of union and intersection, which must comply with certain basic properties (commutative, associative, monotonicity, and border conditions). They are concepts derived from Menger (1942) and Schweizer and

Sklar (1983), and have been explored in-depth more recently (Butnario & Klement, 1993).

Triangular Norm, t-norm complies with the properties of commutativity; associativity; monotonicity, and boundary conditions. The triangular Conorm or s-norm is a binary operation that comply, in a similar manner with the properties of commutativity, associativity, monotonicity, and boundary conditions.

The most widely used of this type of functions are the t-norm of the Minimum and the t-conorm or s-norm of the Maximum as they have retained a large number of the properties of the Boolean operators, such as the property of idempotency Yger (1980). These operators can be can be used as connectors for modeling the intersection and union respectively, as detailed in Dubois and Prade (1980) and Yager (1980). A relationship exists between t-norms (t) and t-conorms (s), which is an extension of De Morgan's Law. When a t-norm or a t-conorm complies with this property, it is said to be conjugated or dual.

T-norms and t-conorms cannot be ordered from larger to smaller (Yager, 1980). However, it is easy to identify the largest and the smallest t-norm and t-conorm:

- Largest t-norm: Minimum Function;
- Smallest t-norm: Drastic Product;
- Largest t-conorm: Drastic Sum; and
- Smallest t-conorm: Maximum Function.

Therefore, it is worth noting that the best option choice is often achieved by method of trial and error. The inferred output of each rule is a fuzzy set scaled down by its firing strength via algebraic product (Jang el al., 1997).

Defuzzifcation refers to a procedure in which a crisp value is extracted from a fuzzy set as a representative value. Hence, the aim is to transform a fuzzy set into a crisp number. Sometimes it is useful to just examine the fuzzy subsets that are the result of the composition process; more often, the fuzzy value needs to be converted to a single number. The literature presents different defuzzification methods and the choice of one for a particular application can be based on an axiomatic and/or empirical justification.

Step 2 refers to the defuzzification process. It is a way by which a crisp value is extracted from a fuzzy set as a representative value. Generally, there are five widely adopted methods to perform defuzzication of a set A of a universe of discourse Z. A brief clarification of the methods using Figure 2.3 follows:

1. Centroid of Area (COA).

This most widely used. It is reminiscent of the calculation of expected values of the probability distributions:

$$COA = \frac{\int_z \mu_A(z) z dz}{\int_z \mu_A(z) dz'} \quad \text{.....(2.7)}$$

Where $\mu_A(z)$ is the aggregated output membership function.

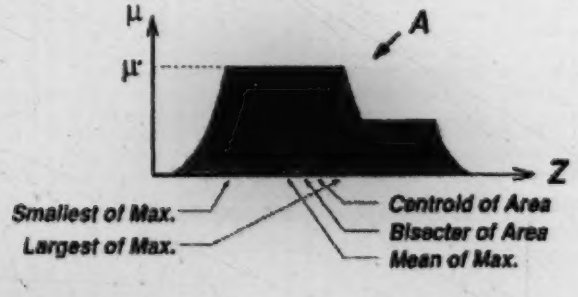

Figure 2.3: Defuzzification Shapes for Obtaining a Crisp Output
Source: Jang et al. (1997)

2. Bisector of Area (BOA).

$$\int_{\alpha}^{BOA} \mu_A(z) dz = \int_{BOA}^{\beta} \mu_A(z) dz \quad \text{.....(2.8)}$$

Where $\alpha = \min\{z | z \in Z\}$ and $\beta = \max\{z | z \in Z\}$. That is vertical line $z = z_{BOA}$ partitions the region between $z = \alpha$, $z = \beta$, $y = 0$, $y = \mu_A(z)$ into two regions with the same area.

3. Mean of Maximum (MOM).

The mean of maximum (z_{MOM}) is the average of the maximizing z at which the membership function (MF) reaches a maximum μ^*. In symbols,

$$Z_{MOM} = \frac{\int_{z'} Z dz}{\int_{z'} dz'} \quad \text{.....(2.9)}$$

Where $Z' = \{z | \mu_A(z) = \mu^*\}$.

4. Smallest of maximum (SOM).

The smallest of maximum (Z_{SOM}) is the minimum (in terms of magnitude) of the maximizing z.

5. Largest of maximum (LOM).

The largest of maximum (Z_{LOM}) is the maximum (in terms of magnitude) of the maximizing z.

Because of their obvious bias, Z_{SOM} and Z_{MOM} are not used as often as the other three defuzzification methods (Jang et al., 1997). Centroid method is the most widely used method. In this research, the centroid method was used, since it satisfies the underlying properties of the system and exhibits the best performance. The centroid method returns the centre of the area under the curve. Braae and Rutherford (1978) have drawn attention to the fact that the control element in generic fuzzy logic controllers is dependent not only on the rules and fuzzy sets assumed, but also on the mathematical operations chosen to define composition, classification, and interpretation.

In their research, Smith and Shen (1998) concluded that there was no overall best inference method for use in their knowledge based system, but that some inference methods performed better than others. In particular the traditional MINMAX approach was not the best performing in their system. Although the authors proved that the maximum value defuzzifier generally had a poorer performance rating than the other defuzztfiers, there was little clear difference between the weighted average and centre of gravity defuzzifiers (which is not surprising as the weighted average defuzzifier is an approximation of the centre of qravity defuzzifier).

The construction and implementation of the fuzzy interference system can be made easy using the powerful capabilities of *MATLAB™* . This is a high performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation.

From Wikipedia, the following limitations were stated for Matlab fuzzy toolbox:

1. MATLAB has no namespace resolution system like the system found in more modern languages such as Java and Python, where classes are located inside packages which can be unambiguously resolved to provide order. In MATLAB, all functions share the global namespace, and precedence of functions with the same name is determined by the order in which they appear in the user's MATLAB path environment variable. Functions are usually not prefixed or otherwise organized logically. As such, two users may experience different results when executing what otherwise appears to be the same code.

2. Many functions have a different behavior with matrix and vector arguments. Since vectors are matrices of one row or one column, this can give unexpected results. There are cases where MATLAB's interpretation of code may not be consistently what the user intended. What might be considered as a convenience for commands typed interactively where the user can check that MATLAB does what the user wants may be less supportive of the need to construct reusable code.

3. Though other data types are available, the default is a matrix of doubles. This array type does not include a way to attach attributes such as engineering units or sampling rates.

4. MATLAB does not support references, which makes it difficult to implement data structures that contain indirections, such as open hash tables, linked lists, trees, and various other common computer science data structures. In addition, the language consistently passes function arguments by value, so any values that change must be returned from the function and re-assigned by the caller. This can, however, be circumvented by declaring variables to be global, which permits access to a value within a function.

Even though these limitations exist, the use of fuzzy logic tool box to help achieve desired results had very little or no effect in its utilization in this research. The depth of utilization of the tool (i.e., integration of five distinct framework outputs through fuzzy rule and membership functions) provided no defined limitations in its utilization. The Matlab fuzzy logic tool box was reasonably sufficient in handling the task it was designed to accomplish.

In conclusion, these Fuzzy sets and logic terms were coined by Zadeh to deal with the phenomenon of vagueness, in the cognition process of the human being (Galindo et al., 2006, p. xii). Zadeh also proclaimed "at present, we are unable to design machines that can compete with humans in the performance of such tasks as recognition of speech, translation of languages, comprehension of meaning, abstraction and generalization, decision-making under uncertainty and, above all, summarization of information" (p. 4). Since then, an enormous quantity of congresses and publications around the world has explored and developed this basic idea of vagueness and its industrial application.

Application of Fuzzy Set Theory and Logic. Although the use of fuzzy set theory and logic has not been extensively applied in postwar reconstruction models, a great deal of work is available in the general construction industry. Fayek (1998) presented a competitive bidding strategy for use in setting margin (markup) for civil engineering and building construction projects. The author's aim in the paper was to provide a method using fuzzy set theory to aid companies in achieving their objectives in bidding and enable decision-makers to assess the impact of those factors relevant to his or her bid situation. Other series of applications are in the areas of project scheduling (Ayyub and Haldar, 1984; Lorterapong and Moselhi, 1995; Oliveros and Fayek, 2005); cash flow / cost analysis (Boussabaine and Elhag, 1998; Mason and Kahn Sr., 1997); evaluation of alternative construction technology (Chao and Skibniewski, 1998), contract decision making (Wong and So, 1994); design performance prediction and Evaluation (Fayek and Sun, 2001); predicting design cost overruns (Knight and Fayek, 2002); contractor selection (Singh and Tiong, 2005); and risk assessment (Tah and Carr, 1999; Tah et al., 1992; Paek et al., 1993).

CHAPTER THREE

3. STUDY CHARACTERISTICS

3.1 INTRODUCTION

A detailed assessment of the factors underpinning postwar reconstruction in devastated municipalities is the focus of this research. Thus, a complete and in-depth understanding of postwar reconstruction decision-making, infrastructure criteria, and application tools will be explored for one devastated district in postwar Sierra Leone. The research design is a case study of Kambia district, northern Sierra Leone, with its seven municipalities.

Since the conflict in Sierra Leone ended in 2002, funding for infrastructure reconstruction by the government and through donor support has been predominantly allocated to the mostly highly devastated districts in the country (see shaded areas in Figure 3.1). The focus of this study is to identify the factors which inform and influence municipality selection for the allocation of infrastructure facilities for reconstruction or rehabilitation. An attempt has also been made to answer the question: **What are the possibilities for service delivery and infrastructure sustainability once the direct involvement of organizations or donor agencies providing financial resources has been removed?** This chapter briefly outlines the research design methodology and provides a detailed description of characteristics unique to this district (as well as to the country of Sierra Leone as a whole). These characteristics are paramount in understanding the impact and sustainability of postwar reconstruction efforts.

3.2 RESEARCH DESIGN

This case study uses a quantitative methodology to analyze the factors considered in the selection of infrastructure projects for the Kambia District postwar recovery plan to rehabilitate or reconstruct the devastated municipalities; (i.e., Kambia district in Sierra Leone and Lofa County in Liberia). Data collection was carried out over a period of two months (May and June, 2007). Each of the seven municipalities of Kambia district was analyzed in terms of the relationships among postwar reconstruction variables (i.e., scale

of destruction, government priorities, donor protocol and conditionality, coordination, etc.).

3.2.1 Kambia District

The Kambia District was selected for this research based on two reasons:

First, it was the first district to have been fully liberated from rebel insurgence (i.e., the Revolutionary United Front (RUF)), (as early as May, 2001). This milestone was followed by the deployment of the Sierra Leone Army (SLA) and subsequently the Sierra Leone Police (SLP) in early June. This exercise opened the district to a humanitarian taskforce and an influx of returnees who had been displaced into other parts of the country during the years of rebel occupation. As a result, initial high scale donor efforts in Sierra Leone were concentrated in this district.

A multi-sectoral assessment of devastated municipalities (conducted by an established technical secretariat of the National Recovery Committee) was carried out in this district (OCHA, NCRRR and MODEP, 2001). A recovery committee was established by the Government of Sierra Leone (GOSL) to look specifically at critical requirements for the restoration of civil authority in devastated districts. Initial engagement in executing postwar reconstruction activities in the district resulted in a greater amount of diverse data than from similar devastated districts in the country. Credible, adequate, and relevant data are critical components of this research work.

The second reason Kambia was selected for this study was its geographical location relative to Liberia, chosen to validate the Methodology. Lofa County in Liberia borders the other highly ravaged districts in Sierra Leone. Inter-regional border activities were high in these regions, and such a situation created commonalities among them. Kambia borders Guinea (see Figure 3.1) which made the choice ideal for this research.

3.2.2 Characteristics of Kambia District

This district is located in the northwest of Sierra Leone, along the border of Forecariah Prefecture in the Republic of Guinea (Conakry). It is the smallest of the 12 districts in Sierra Leone. It borders Guinea to the north, Port Loko District to the south, and Bombali District to the east (Figure 3.2), occupying a total of 3,108 Km.^{2} The main

ethnic groups are Soso, Limba, and Temne. The district headquarter are housed in Kambia town. The main economic activities include small-scale mining, livestock (small ruminants) and food crops (cashew nuts). The district is predominantly Muslim in religious affiliation. Administratively, the district is divided into seven municipalities or chiefdoms: Bramaia, Gbinleh- Dixing, Magbema, Mambolo, Masungbola, Samu, and Tonko-Limba. A Paramount Chief and a council of Tribal Authorities govern each of these chiefdoms. The central government is comprised of a District Council Chairman and an elected District Council. These institutions were destroyed during the civil conflict and are now being rehabilitated.

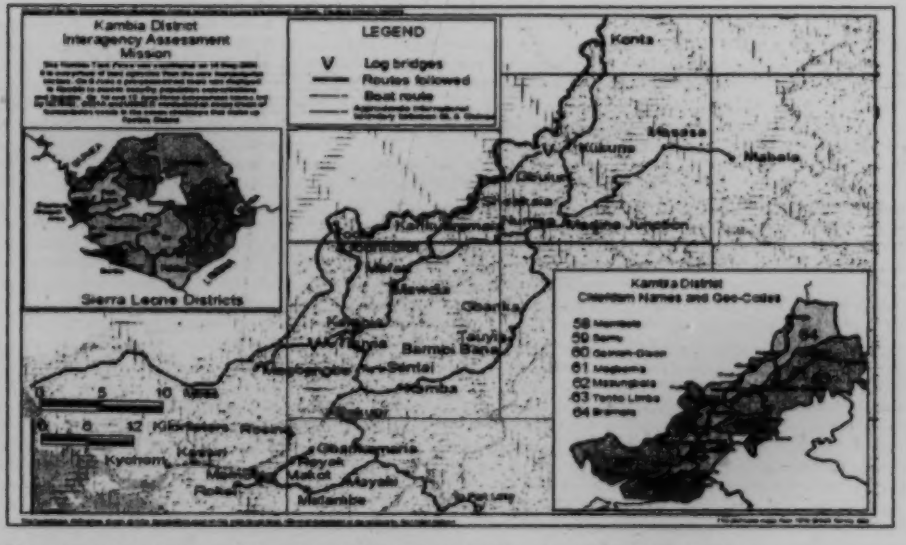

Figure 3.1: Map of Kambia District showing the Municipalities

3.2.3 Demographic Trends of Municipalities/Chiefdoms

This research emphasizes an understanding of the socio-economic and demographic characteristics of the municipalities (see Table 3.1). The distances in kilometers between each town to Kambia District headquarters is noted. Based on the deplorable conditions across the entire road network in the District, the difficulty associated with accessing facilities provided in and/or by the district headquarter town was apparent. The discussions of various municipalities are based on a cumulative

Table 3.1: Road Network Distances to District Head Quarter and status

Municipality/Chiefdom	Town/Village	Distance to District Head Quarter Town, Kambia (in Km)	Status of Road
Briama	Konta	54	Poor
	Kakuna	38	Poor
	Gbolon	25	Poor
	Shekaia	18	Poor
	Kanbu-Briama	12	Good
	Baroguya	40	Poor
Gbinleh-Dixon	Mafaray	9	Poor
	Tawuya	6	Poor
	Magbengbeh	12	Poor
	Gbanlamuya	5	Poor
	Warreh	7	Poor
Magbema	Kawula	7	Poor
	Baimoi Munu	14	Good
	Kania	10	Poor
Mambolo	Mayarkie	28	Poor
	Mambolo	35	Poor
	Kalankay	50 (Nautical)	Impassable
	Tombo Walla	35 (17 Km land 18Km riverine - Nautical)	Seasonal
	Rokel	38	Poor
Masungbala	Magbethie	8	Poor
	Modia	6	Poor
	Mattouraneh	4	Poor
	Senthai	6	Poor
	Rokupr	12	Poor
	Gbonkomaria	24	Poor
	Meni Curve	12	Poor
	Barmoi Luma	8	Poor
	Gbalanthun	25	Poor
Samu	Rosinor	30	Poor
	Koya	27	Poor
	Mafuneh	23	Poor
	Kassirie	35	Poor
	Kychom	35	Poor
	Rokai	70 (Nautical)	Boat Use Only
	Yeliboya	60 (Nautical)	Boat Use Only
	Mapotolon	42 (Nautical)	Boat Use Only
	Moribiaya	35	Poor
	Solobolomaia	35	Poor
Tonko Limba	Sella Kaffa	18	Poor
	Masellen	23	Poor
	Numea	20	Poor
	Madina	25	Poor
	Kamassasa	35	Poor
	Kamagbewu	34	Poor
	Kasoria	56	Poor

representation of these towns and villages. These towns, with the exception of Madina and Kamassassa are all located along the great Scarcies River which provides an important (trade) route to Guinea and Freetown. All of the chiefdoms had medical centers or posts, with one referral hospital located in Kambia town. There are few means of transportation in any of these places to Kambia town. This deficiency contributed to this district's mortality rate (especially infant and maternal mortality) exceeding all other districts in the country. There were also 13 secondary schools in the district, located in Kambia town, Rokupr, Kasirie, Kychom, Mambolo, Tombowala, Madina, Kamassassa and Kukuna. Three of these 13 schools together with the hospital were burned down in February 1999 during intensive fighting, while the remaining 10 were systematically vandalized to the point of almost total destruction.

As this district was targeted later than most other areas of Sierra Leone, it had hosted a huge number of Internally Displaced Persons (IDPs) until September 1998, when it sustained a heavy rebel attack by the RUF. Much of the population, together with over 40,000 IDPs who had sought refuge there, fled to neighboring Guinea. The inhabitants of this district constitute the majority of the refugees in the Forecariah Prefecture (District).

An analysis of demographics detailing quality of life indicators in the various municipalities is presented in the following sections.

Population. The district had a pre-war population of about 186,231 inhabitants with the following ethnic distribution : Temnes (40%), followed by the Soso (28%), the Limba (21%), and the remaining being other ethnic groups like the Fullahs, the Madingoes, etc. The most populous town and district headquarter is Kambia town, with an estimated pre-war municipal population of about 39,505 (refer to Table 3.2). This town had the highest population density in both the pre- and post-war periods. Other larger towns are Rokupr, Mambolo, Madina, Kukuna Kasirie, Kychom, Kamassassa, and Tombowala, with populations ranging from 10,000 to 25,000

Table 3.2: Pre- and Postwar Population

Municipality/Chiefdom	Prewar population (1985)	Total Estimated Return (Refugees, Returnees, and IDPs
Bramaia	16,524	9,725
Gbinleh Dixon	10,728	4,150
Magbema	39,505	4,938
Mambolo	26,775	3,400
Masungbala	19,326	1,051
Samu	42,434	2,073
Tonko Limba	30,939	530
Total	**186,231**	**25,867**

Source: District Recovery Committee Report, 2003, 2nd Data Collection Exercise.

Education. The education sector was seriously disrupted in the district (refer to Table 3.3) as a result of the conflict. School buildings were either burned completely or sustained serious damage to walls, or destruction of roofs, windows, and doors. Any schools still able to function lack adequate furniture, and collapsed or dysfunctional sanitation facilities exist in all municipalities. Nearly all of the schools assessed lack water wells or water pipes. The schools do not have sufficient teaching and learning materials.. There is also a general problem of overcrowding in the classrooms, mainly as a result of a lack of teachers. Many of the qualified teachers fled the district and therefore 60%-70% of the teachers currently present are unqualified (Inter-Agency assessment Report, 2001). There is no teacher supervision in the district since the supervisors still remain outside the district. One of the major hindrances to the return of teachers and school inspectors is the lack of available accommodation.

The district had 147 primary schools and 10 secondary schools prior to war. Of these, 71 primary schools and 4 secondary schools are still not operational, and require complete reconstruction. The remaining schools require rehabilitation to raise them to a minimum functional level, as well as the replenishment of teaching and learning materials and furniture. The rate of annual enrolment in primary and secondary education is very low and not commensurate with the actual population of children, who constitute over half of the population of the district. Enrolment, as mentioned, is also lopsided in favor of male students.

Table 3.3: Status of Primary Education in the District

Municipality/ Chiefdom	Total # of Schools	Destruction Category				Students		Teachers		Resource Availability	
	"Pre- war"	1*	2*	3*	4*	Registered	Non-Registered	Qualified	Unqualified	Texts	Others
Bramaia	11	1	2	1	7	2,668	1,200	11	29	Poor	Poor
Gbinleh-Dixon	10	0	0	2	8	2,986	800	13	19	Very Poor	Very Poor
Magbema	27	6	8	6	7	11,473	2,100	90	69	Poor	Poor
Mambolo	22	0	2	8	12	6,880	1,300	23	51	Very Poor	Poor
Masungbala	13	0	1	3	9	4,301	1,200	11	29	Poor	Poor
Samu	26	2	4	4	15	9,271	820	25	71	Very Poor	Poor
Tonko Limba	38	3	8	11	16	8,074	750	28	60	Very Poor	Poor
Total	147	12	25	35	74	45,653	8,170	201	328		

Source: Field Data

1* = Infrastructure facility is in perfect condition

2* = Facility sustained minimal devastation

3* = Major destruction of facility, and

4* = Facility completely destroyed

A study conducted in the Kambia District by UNAMSIL's Human Rights Section has shown that during the 2003/04 academic year 30,287 boys and 20,975 girls enrolled in primary education but only 3,117 boys and 640 girls were enrolled in secondary education. Most teachers are unqualified, as detailed in Table 3.3.

Economics. The high illiteracy rate of citizens, especially among women, can in part be explained by the higher demand for female labor in the family. Girls are required to work in the house at an early age, given that their mothers are often overburdening with the tasks of taking care of the household and the children and doing farm work. Another contributing factor to women's illiteracy is the traditional practice of early forced marriage, which is very common in the provinces (Sexual violence in Sierra Leone Conflict, 2003, p. 22). The municipalities' population is primarily engaged in subsistence farming, with women constituting 80% of the labor that produces 70% of the nation's food. This agricultural labor is generally not remunerated by cash wages and as a result women have unequal access to land or technology. In Sierra Leone, the different ethnic groups continue to operate under communal and family land holding systems. Women can use the land for subsistence farming but the control and management of the land and any property on it is vested in the male head of the family. With the post-war resettlement process underway, war widows returning to their villages of origin often lack the legal means or community support to reclaim their families' property (International Religious Freedom Report, 2005, p.22).

Health. Health infrastructure bears the effect of the war in all municipalities in the district. The single district hospital suffered complete destruction. All cases must be referred to the neighbor district hospital in Port Loko. Most community health centers in the district are essentially intact, although at least 50% of these are dilapidated through disuse and neglect (Table 3.4) and require some form of rehabilitation and re-equipping. Throughout the district, drugs, medical equipment, and furniture are either unavailable or minimally available. While there are some Ministry of Health employees present in some communities, these tend to be ancillary (UNHCR, 2004, p. 34).

Table 3.4: Status of Health Facilities in the District

Facility		Municipality Braima	Gbinleh-Dixon	Magbema	Mambolo	Masungbala	Samu	Tonko Limba
Hospital	Prewar	None	None	1	None	None	None	None
	Postwar	None	None	0	None	None	None	None
Status				Completely destroyed				
Comments				Currently operates from a rented building				
Health Centers	Prewar	4	2	5	3	2	7	5
	Postwar	2	2	2	0	2	1	5
Status		2-minor damage and 2-Major damage	All minor damage	3- completely destroyed, 1 minor damage and 1 major damage	All completely destroyed	2- minor damage	6-completely destroyed and 1 minor damage	2-minor damage and 3 major damage
Comments		No staff Quarters			Service provided from a private home	No staff Quarters	Service provided from a private home	

Source: Survey Data

There are virtually no trained medical staff remaining who would be capable of providing or supporting primary health care services. Most have fled the war and have chosen not to return, due to lack of accommodation or other issues. Additionally, low salaries of health-care personnel, including doctors, have contributed to a mentality among most of the medical officers of being reluctant to stay and work (United Nations Economic and Social Council, 2005, p. 11). This shortage of doctors and qualified medical staff has led to the prevalence of the quack medical personnel known locally as "pepper doctors." These practitioners are mostly untrained and constitute hazards to unsuspecting citizens. Often their interventions lead to further health complications or even death.

Internal security. Among the Government's security forces, the Sierra Leone Police (SLP) officially has primary responsibility for internal order. The SLP's greatest challenges are insufficient resources and a lack of investigative or forensic capabilities, and they are widely perceived as corrupt and incompetent (UNHCR, 2004. p. 34). During the civil war, numerous officers were killed or fled their posts, which resulted in a reduction of the district's police force from approximately 120 officers to 32. Budget constraints have impeded recruitment efforts, as has the lack of basic educational skills of applicants, many of whom had had no schooling during the civil war. The basic equipment that the police force lacks includes transport, radio communication, and proper uniforms (UNHCR, 2004, p. 34).

The distributional pattern of security personnel in the different municipalities as shown in Table 3.5 is critical.

Table 3.5: Police presence in municipalities

	Municipality/Chiefdom						
	Briama	Gbinleh-Dixon	Magbema	Mambolo	Masungbla	Samu	Tonlo-Limba
Facility	Police post	Police Post	Police Station	Police Post	Police post	Police Station	Police Station
Status	Destroyed	Minor Destruction	Major Destruction	Destroyed	Destroyed	Major Destruction	Minor

Source: Survey Data

The limitation in number of police personnel, transportation (vehicles), and difficulties associated with access to some municipalities (i.e., poor road conditions and riverine nature) have impeded proper police personnel distribution and district-wide coverage.

Table 3.6 highlights the investigation of reported crime incidents (January to May, 2007), and highlights that assault is the most frequent crime committed in the district.

Table 3.6: Number of reported cases of crime in the district (January – May, 2007)

	Municipality			
Type of Crime	Magbema	Masungbala	Samu	Tonko limba
Assault	46	9	5	6
Larceny /House Breaking	12	7	3	5
Fraudulent Conversion	13	3		3
Riotous Conduct	2	1		
False Pretence				2
Threatening Language	7	3		3
Malicious Damage (wounding)	8			
Murder	1	1		
Possession of Arms	2			2

Source: Survey Data (Extract from district police monthly report)

The reports on Briama, Gbinleh-Dixon, and Mambolo were unavailable during the data collection period as there were no reported cases of crime.

Confidence of citizenry in elected authority. The district has exhibited a loss in confidence in the local authority, and this perception has manifested a negative implication for security in the district and also for the way projects are embraced. There seems to be a general sentiment that the rich and influencial will always receive benefits from reconstruction initiatiaves and justice whereas the poor will be denied. Stories of chiefs' partisanship, favouritism, nepotism, and unaccountability seem to have been prevalent among the people. While going to the chief may be a better option than taking a case to the local court or to the SLP, bribes and unfounded rulings have come to be expected nonetheless (National Forum for Human Rights, 2003, p. 28).

Local customs. As iterated in the Forum for Human Rights document (2003, p. 26) there are strong family ties within municipalities. Ethnically, the district has three main groups that speak distinct primary languages (Table 3.7) and are concentrated in specific regions or municipalities. Ethnic segregation is apparent in some regions and

inter-ethnic marriage, although rather commonplace, may be of serious concern in other municipalities. The two largest ethnic groups are Temne and Soso. There have been reports of inter-ethnic tension (Human Rights Report, 2005, section 5), and ethnic loyalty has remained an important factor in government, armed forces, and business. Complaints of ethnic discrimination in government appointments, contracts, military commissions, and promotions have been common (Human Rights Report, 2005, section 5).

Women and Societal Discrimination. In theory, Sierra Leonean women are granted equal rights to men under the 1991 constitution. However, discrimination is permitted, inter alia, under laws dealing with "adoption, marriage, divorce, burial, devolution of property on death, or other interests of personal law," which have direct bearing on the rights of women, as well as indirectly as manifest in customary law. This important contradiction in the constitution (similar to that in many African constitutions) has contributed to the low status of women in Sierra Leone. It legitimizes the application of discriminatory customary law, for which there is no protection. Customary and Islamic laws also continue to be widely applied (Sexual Violence in Sierra Leone Conflict, 2003, pp.16-17). The rights of married women remain limited (Table 4), particularly for those married under customary and Islamic laws. Most households are polygamous, apart from the monogamous Christians (approximately 30% of the population).

Domestic Violence. Societal attitudes toward domestic violence are another indicator of the status of women and girls in society; physical violence against women and children is common in the municipalities. Indeed, under customary law, under which a single act of physical and brutal force is permitted. Although wife-beating and other forms of matrimonial violence are rife in the communities, very few such cases ever reach the police or a family support unit. Fewer such cases reach the courts, with the majority settled out of court. Out-of-court settlements including locally-arranged financial compensation to victims or relatives also serve to limit judicial redress and encourage impunity within the community (United Nations Economic and Social Council, 2005, p.9).

Child labor. Children in Kambia District have routinely assisted in family businesses and worked as petty vendors (refer to Table 4.). Adults have employed a large number of street children to sell, steal, and beg. In most municipalities, children work

seasonally on family subsistence farms. Hundreds of children, including some 10 years old and younger, have mined in alluvial diamond fields, employed by their relatives. Because the adult unemployment rate remains high, few children have been involved in the industrial sector or the formal economy (Human Rights Practices in Sierra Leone, 2003, Section 6).

Early forced marriage. The Final Report of the Truth and Reconciliation Commission of Sierra Leone (2004) states that early marriages (under the age of 18 and permitted under customary law systems) pose a major challenge to the government because these young adults have no skills to help support their children. There is no minimum age of marriage and the practice of early marriage has contributed to high levels of sexual abuse and has led to society's condoning of a practice detrimental to the development of young girls. Hence, the Human Rights report on sexual violence in the Sierra Leone civil war (2004) states that the health of many women and girls in the municipalities is compromised by early forced marriage, where men often sponsor a girl from birth (paying for school fees, clothes, etc.) and marry her after she has been initiated into womanhood. Girls who are forced to marry early miss out not only on education but on skills training opportunities, and are therefore highly dependent on their husbands (Violence in the Sierra Leone Conflict, 2003, p. 23). This may also contribute to the high maternal mortality rate in Sierra Leone since young girls will often bear several children before their bodies are fully mature. At 1,800 maternal deaths per 100,000 live births, Sierra Leone's maternal mortality rate is one of the highest in the world, and translates to some 4 000 maternal deaths per year based on a total population of five million.

Secret Societies. The National Forum for Human Rights report, "The Law People See: The Status of Dispute Resolution in the Provinces of Sierra Leone in 2002," defined secret societies as single-sex communities that operate in the bush. These secret societies purport to fulfill only the functions of preparing men and women for adult life in the traditional tribal context and begin with training for adulthood, an initiation which usually includes circumcision and traditional ceremonies. Unless an individual is initiated, he or she is neither considered a true tribal member nor an adult ready for marital responsibilities. As a result, nearly everyone living within the municipality, particularly in the case of Tonko Limba (Table 4), belongs to a secret society. These societies operate

under their own isolated legal systems, defining their own laws, procedures, and punishments. They oversee their own jurisdiction, and any conflicts or crimes arising "out of the bush" stay within the secret society purview. Secret societies have always been an integral part of Sierra Leonean culture. They incorporate a spiritual and traditional element highly prized by the entire community.

Disability Issues. With regard to the status of disabled persons in Sierra Leone, there is not yet any government policy or programme directed particularly at persons with disabilities. There is no overt discrimination in terms of housing, education, or training; however, given the high rate of general unemployment, work opportunities for persons with disabilities are few (Human Rights Practices in Sierra Leone, 2005). Notably, and on a positive note, a few private agencies and organizations have provided job training for persons with disabilities in Kambia District. In addition, some of those maimed in the fighting, or who had their limbs amputated by rebel forces, have received special assistance from various local and international humanitarian organizations. Such programmes have involved reconstructive surgery, prostheses, and vocational training to help victims acquire new work skills (Human Rights Practices in Sierra Leone, 2005, Section 5).

Corruption. In the 2005 Transparency International Corruption Perceptions Index (CPI) of 159 countries, published in October, 2005, Sierra Leone is ranked as the 129th most corrupt country, with a CPI score of 2.4. The CPI (scores range from 10--not corrupt to 0--highly corrupt) defines corruption as the abuse of public office for private gain, and measures the degree to which corruption is perceived to exist among a country's public officials and politicians. In 2000, the GOSL promulgated the Anti-Corruption Act, under which the Anti-Corruption Commission (ACC) is responsible for combating corruption. By the end of 2004, the ACC had 135 corruption cases under investigation, had won 13 cases, and had secured indictments against 6 high-level officials (Human Rights Practices in Sierra Leone, 1005; Section 3).

A summary of the characteristics, just discussed, for the district (Kambia District) is outlined in Table 3.7. An understanding of these characteristics also provides the basis for the first framework (Sustainability capacity of municipalities) of the model discussed in the next chapter. The next chapter provides a detailed description of how these

characteristics can be utilized to provide a measure of municipalities standing as well as for ensuring sustainability and the continuation of service delivery for reconstruction.

Table 3.7: Demographic Characteristics of Kambia Municipalities

Characteristic	Municipality						
	Briamia	Gbinleh-Dixon	Magbema	Mambolo	Masungbala	Samu	Tonko Limba
Religion: Muslim	Major	Major	Medium	Major	Major	Major	Minor
: Christianity	Minor	Minor	Medium	Minor	Minor	Minor	Minor
Economic Activities	Farming	Farming	Business	Fishing	Trade	Fishing	Farming
Transportation- Roads	Bad Roads	Bad Roads	Average roads	Seasonal Access	Bad Roads	Seasonal Access	Bad Roads (partly seasonal)
Tribal Domination	Sosos	Sosos	Cosmopolitan	Traditional Society	Moderate	Moderate	Low
Female Labor	High	High	Moderate	High	High	High	High
Discrimination against women	Moderate	Moderate	Low	Moderate	Moderate	Moderate	Moderate
Domestic violence	Moderate	Moderate	Low	Moderate	High	Moderate	Moderate
Child Labor	Moderate	Average	Moderate	High	Moderate	Moderate	Moderate
Influence of secrete societies	Low	Average	Low	Average	Average	Moderate	High
Communication coverage (Cell Phone)	Poor	Average	Good	Poor	None	Poor	Poor
Local Administration Problems	Very High	Moderate	Moderate	Very High	Minor	Minor	Very High (Party Affiliated Paramount Chief)

Source: Survey Data

CHAPTER FOUR

4. RECONSTRUCTION IMPACT MODEL FRAMEWORK

4.1 INTRODUCTION

Good interaction and information links are required for best operation of both infrastructure systems and the management processes (Thorpe, 2000). The interactions provide the platform for proper understanding of the perspectives of the infrastructure development and management of the components of the infrastructure environment. Figure 4.1 shows the range of factors influencing the development and operation of infrastructure over its life cycle.

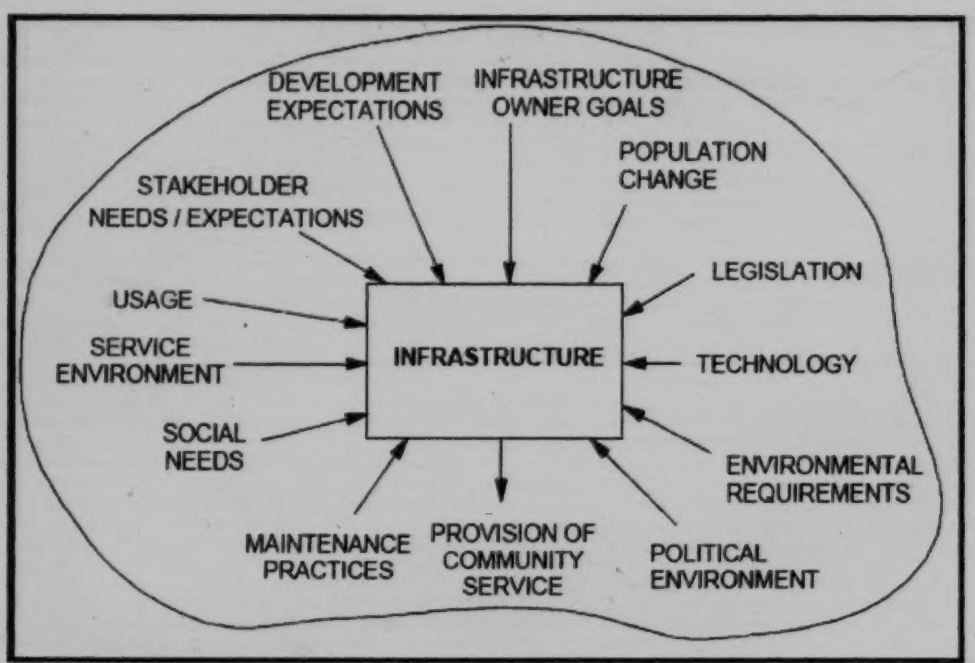

Figure 4.1: Components of postwar Infrastructure Environment
Source: Thorpe, D. S. (2000).

Most of these factors were presented in detailed in previous chapters. The components arise not only from the engineering requirements, but also from social, political, and donor influences; such as legislation, social need, funding procedures and

processes, environmental and political requirements. These diverse requirements need to be taken into account by postwar reconstruction decision makers.

A strategic and integrated view is one that is needed to address the many concerns presented in Figure 4.1. If the rebuilt infrastructure facilities are to provide adequate levels of service deliveries and ensure such services are maintained at minimum whole life cost, holistic approach to addressing the different components of the infrastructure is given a comprehensive attention. One major consideration in achieving this, is defining the degree of integration between the components of the infrastructure environment in Figure 4.1. The task, however, is how the qualitative variables as well quantitative variables of the components of the infrastructure environment should be measured. Because of the complexities of these components, and the requirements to balance the concerns of the stakeholders, detailed consideration of all components (using tools like AHP, Semantic Differential and Hamming Distance techniques, and fuzzy logic) is adopted by this research. This chapter provides a detailed analysis of the procedures used in adopting the various tools discussed in Chapter 2. Descriptions of factors important in postwar reconstruction are discussed using a three-phase approach as illustrated in Figure 4.2.

Phase 1 analyses five distinct frameworks (FWs) that characterize key factors in postwar reconstruction situations: sustainable capacity (FW1), donor procedures and practices (FW2), current infrastructure state (FW3), government national priorities (FW4), and coordination effectiveness (FW5). An assessment of these five factors provides an indication of the quality of life of citizens in postwar municipalities. Each of these frameworks and along with their accompanying discussions of the related factors is explained in greater detail in the sections below.

Phase 2 describes the integration of the numerical output values of the frameworks utilizing fuzzy rules to obtain a measure of impact generated by a reconstructed infrastructure facility in municipalities affected by war.

Phase 3 utilizes the outputs of Phase 2, the associated cost of reconstruction or rehabilitation of facilities, and any associated constraints in an optimization model. This model uses LINGO software to allocate facilities/funding to municipalities for reconstruction. The methodology adopts the use of an impact-based evaluation that

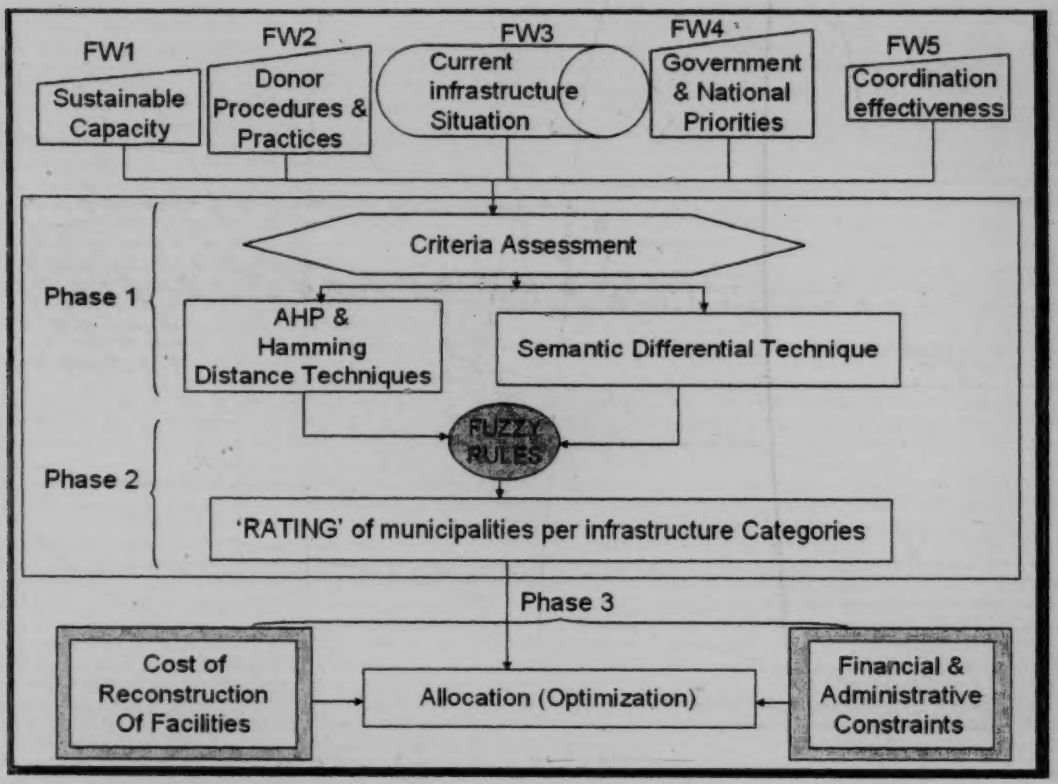

Figure 4.2: Infrastructure Reconstruction Impact Model

assesses sustainability capacity of municipalities (Framework 1), donor procedures and practices (Framework 2), current infrastructure state (Framework 3), government and national priorities (Framework 4), and coordination effectiveness (Framework 5). A rule-based technique using fuzzy rules is used to integrate the outputs of the frameworks to obtain a holistic representation of the measure of impact on quality of life generated through the reconstruction of an infrastructure facility. The outputs of the integrated model are used in a linear optimization (in a LINGO program) model to allocate funds and select municipalities for infrastructure reconstruction.

Data Collection. In-depth interviews, filling out questionnaires using focus group discussions on the seven categories (education, health, water & sanitation, security & safety, administration, transportation, and social services & recreation) of infrastructure and key informant meetings are the data collection tools. In addition, as the time for collection of the data was a constraint, the researcher often relied on reports, evaluations and existing written sources (reports of agencies operating in the district). At the

municipal level, nine in-depth interviews were conducted. Both Technical (in the various categories of infrastructure service deliveries) and administrative personnel took part in the exercise. Five sessions each for the donor, government and coordination survey were conducted (2 in Freetown, the capital of Sierra Leone, and 3 in the municipalities of the survey district, Kambia). Both the relevant organization (Appendix 1.1) operating in the district and community members were interviewed and made to provide responses to the questionnaires. The assessment for the current states of the infrastructure facilities was purely technical and the evaluators are engineers and superintendents working in the district.

The data collection exercise with the associated interviews was conducted in April and May 2007. The set of questions and themes were developed by the researcher and they went through an ethics review committee for approval. A few key information sharing activities with stakeholders (i.e., United Nations Development Program Office, National Commission for Social Action, and the ministries of education and health) in Sierra Leone helped in the design of the questionnaires in appendices 6 to 10. This was made possible through e-mails and personal telephone conservation with the researcher. The questions asked about implemented postwar reconstruction initiatives by donors, government, and how the devastated municipalities were reciprocating to those development initiatives. They explored factors that had an effect (either negative or positive) on reconstruction initiatives. Issues like accountability and transparency mechanisms, whether the designed survey tools were applicable to local realities, the local understanding of government incapacity to provide fully their needs in replacing the destroyed facilities, whether the efforts made by government and the international communities in responding to reconstruction made meaningful impact to the populations, and how the different demographics of the municipal citizens contribute to the reconstruction process.

A similar set of questionnaires, and questions were used when it came to assessing the communities in Lofa County in Liberia to validate the model. There were two interviews and a couple of telephone conversations Liberia's focus groups and government and donor agencies. The survey exercise, including interviews, took place in

May 2007 and questions looked at the same parameters discussed for Kambia District in Sierra Leone.

4.1 PHASE 1:

Sustainable Capacity (FW1). The concept of sustainable capacity as discussed in Chapter 2 is difficult to quantify, as there exists no underlying, physical, measurable scale. Instead, this important indicator is usually assessed qualitatively through the deployment of social surveys/interviews during which target groups make assessments of municipal characteristics, which in turn are used to evaluate sustainable capacity. This research utilized the Analytic Hierarchy Process (AHP) methodology (discussed in Chapter 2) to capture and rate municipalities' characteristics as factors which influence the sustainability of proposed facilities for reconstruction, with particular reference to underdeveloped countries. The Hamming Distance technique was then used to determine to what extent municipalities deviate from normal societies (a society that have not gone through devastation associated with civil conflict), referencing Sub-Saharan Africa benchmark of the indices of quality of life.

The researcher's three years of postwar reconstruction experience in Sierra Leone bolstered by findings during data collection confirmed that sustainability had been threatened by a severe lack of local competency to maintain existing and rehabilitated infrastructure. This trend seems to have been amplified by the urgency to rebuild infrastructure rapidly in the absence of a well-defined framework to assess the capacity of municipalities--a circumstance which had compromised long-term sustainability. Drawing on the experience of Brown (2002) in East Timor and North Maluku, it should be noted that government-instituted obstruction of technical and managerial enhancement of the local citizens often leads to a lack of sustainability of reconstructed facilities.

FW1 (sustainable capacity) underscores the importance of understanding the culture and organization of prewar municipalities, as discussed in previous sections. It also provides the basis for ensuring that reconstruction plans reduce rather than increase individual and municipal vulnerabilities by providing what people need, cherish, and can afford to maintain for a long time.

The criteria used for evaluation (see Table 4.1) serve to quantify the measure of "need" of municipalities in a holistic manner for each infrastructure category (Education, Health, Water and Sanitation, Transportation, Security and Safety, Administration and Social Services, and Recreation). These criteria are extracted from the characteristics exhibited by municipalities and are based on the knowledge of experts who have spent many years working on development projects in these categories. The criteria are also ordered to bolster programmes designed to promote progress in the areas of intellectual, social, and physical development of citizens in a given municipality. Specific criteria such as "economic condition of municipality, ethnicity and heterogeneity of citizens, and affordability of service" are common in almost all categories. In order to assess municipalities and obtain a numerical measure of these characteristics, survey questionnaires were formulated reflecting an analysis of a specific infrastructure category. With respect to a specific infrastructure category criteria illustrated in Table 4.1, the approach adopted was focused on the involvement of experts in the field who are working towards the restoration of different infrastructure categories.

The experts from whom the relevant data was collected comprised a combination of personnel from NGOs, government ministries, donor organizations, and affected municipalities. These expert groups provided advice about the selection of relevant criteria; assigning relative weights across the criteria; and ranking of the criteria relative to the municipalities. They also provided numerical values of the criteria relative to current quality of life in the municipalities, and made recommendations as to their ideal values based on a Sub-Saharan Africa benchmark. Seven focus groups, one for each infrastructure category, were established during one of the inter-agency[1] meetings. Table 4.1 illustrates the factors identified by experts that associate with each of the infrastructure categories. Each infrastructure category and the associated descriptors were assessed separately among the seven competing municipalities in Kambia District. Every group member was requested to identify the degree to which every factor affected the municipalities devastated by war.

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[1] Monthly meetings of reconstruction players: NGOs, donors, national and local government representatives operating in the district. They used the forum to share information on current issues in the district and finding solutions to problems encountered by the different organizations. It is the knowledge sharing base for the district.

Table 4.1: Infrastructure Categories Criteria

Education	Health	Water and Sanitation
▪ Economic condition of municipality ▪ Ethnicity and heterogeneity of municipal citizens ▪ Affordability of service ▪ Involvement of education ministry ▪ Education policy coordination ▪ Equitable compensation for staff ▪ Views of parents stakeholders ▪ Literacy Rate ▪Conditions and physical well-being of students	▪ Economic condition of municipality ▪ Ethnicity and heterogeneity of municipal citizens ▪ Affordability of service ▪ Degree of involvement of different service providers ▪ Health policy coordination ▪ Equitable compensation for staff	▪ Economic condition of municipality ▪ Ethnicity and heterogeneity of municipal citizens ▪ Affordability of service ▪ Preference of citizens ▪ Maintenance capability of personnel
Transportation	**Security and Safety**	**Administration**
▪ Economic condition of municipality ▪ Ethnicity and heterogeneity of municipal citizens ▪ Alternative transportation Modes ▪ Condition of road network	▪ Economic condition of municipality ▪ Ethnicity and heterogeneity of municipal citizens ▪ Citizens Perceptions and Concerns ▪ Social Safety net Schemes	▪ Economic condition of municipality ▪ Ethnicity and heterogeneity of administrators ▪ Administrative capacity and policies ▪ Citizens perceptions and concerns ▪ Participation of citizens
Social Services and Recreation		
▪ Economic condition of municipality ▪ Ethnicity and heterogeneity of citizens ▪ Administrative capacity and policies ▪ Citizens perceptions and concerns ▪ Participation of citizens		

To assess the municipalities relative to the specific infrastructure category criteria illustrated in Table 4.1, two distinct values for each criterion were assessed. The first is a

measure of a value as indicated in the United Nations Human Development Report for Sub-Saharan Africa (2003). If a value was not stated for the criterion, experts were asked to provide one. Table 4.2 provides a description of the notations used in the formulations.

Table 4.2: Notations and their definitions

Symbolic Representation	Definition
μ	Measure of the level associated with quality of life characteristic
I	Ideal baseline
M	Municipality
C	Specified criteria within an infrastructure category
u	Properties for which both absence or excess of a criterion are penalized
v	Properties for which only absence of a criteria are penalized
i	Number associated with the municipality; 1,2……,7
$\mu^I(C_v)$	Ideal level for C_u
$\mu_i^M(C_v)$	Level possessed of C_v by the municipality
E, H, W/S, T, SS, A, SS/R	Education; Health; Water & Sanitation; Security & Safety; Administration; Social services & Recreation, respectively

For Third World country situations, this researcher typically refers to the quality of life indicator values as being ideal for a "normal society." These numerical ideal values are referred to as μ^I in this impact-based reconstruction model formulation. The second value provides an indication of the current situation of municipalities under each criterion, as assigned by those evaluating the municipality infrastructures. These values are referred to as the present status of municipalities, μ^M, in the model. The criteria are distinguished through their separation into "u" and "v" groups (arbitrary letters assigned by the authors); where the "u" refers to the criterion required by a municipality in order to attain the ideal value. However, if the current value of a criterion exceeded the ideal value for a particular municipality (e.g. economic condition of municipality), it was deemed acceptable. The "v" represented the value that a municipality must have in order to be considered ideal. For "v" criteria, as opposed to "u" criteria (e.g. involvement of education ministry), it was unacceptable for values to exceed ideal values. To further clarify the approach using the education category, for instance, an equitable staff

compensation value exceeding the ideal value was acceptable, hence the "u" category classification (required for a municipality in order to attain or exceed an ideal value). For the same education category and the "educational policy coordination" criterion, a numerical value exceeding the optimal level was deemed unacceptable, hence the "v" category classification. However, the criteria do not necessarily denote equal ratings of importance within municipalities. They were assessed, rather, according to their contribution to the sustainable infrastructure category under discussion. An AHP was used to develop the relative weights, $\overline{w}_i$, of infrastructure categories with respect to each municipality. The weighted values were then used as inputs in the Hamming Distance application.

- This Hamming Distance concept was used to determine the difference in values of the quality of life criteria as defined within the context of particular infrastructure categories. This value was defined as the difference between the ideal criteria value (Sub-Saharan Africa standard), and the current measure ("u" or "v") of the criteria in municipalities. The criteria weights, the ideal criteria value, and the present municipality values were used in Equation (4.1) to compute the sustainable difference, G_i, between municipalities.

$$G_i = \sum_u \overline{w}\left[\mu^I(C_u) - \mu_i^M(C_u)\right] + \sum_v \overline{w}\left[\max\left\{0, (\mu^I(C_v) - \mu_i^M(C_v))\right\}\right]$$

$i = 1, 2, 3 \ldots\ldots 7$ .....(4.1)

Ideal level of criterion

Existing level in Municipality

Where:

$\overline{w}_i$ is the relative weight of each criterion in table 4.1;

C is the criteria value.

- The first computation evaluated criteria falling under the "u" category. Here, the difference was acceptable.

- The second computation evaluated the criteria falling under the "v" category. In this case, the maximum of the values "zero and the difference" was adopted. A penalty was instituted in such a case.

To provide a measure of capacity of municipalities to sustain rebuilt infrastructure (which also provide an indicative measure of need) the inverse of the numerical values of G_i were used as illustrated in equation 4.2.

$$\overline{G}_i = 1/G_i \quad \text{.....(4.2)}$$

Analysis of the population size and the categorization of citizen groups by "age, ethnicity, religion, and cultural setting" provided insight into how citizens engaged in social and economic activities. These characteristics serve to create a tight community within a local population. The population size of a municipality affected diversification with respect to both sector groups and institutions within that municipality. Moreover, in order to sustain reconstructed infrastructure facilities, the population imbalance between municipalities must be incorporated into Equation (4.2).

$$\Theta_i = \frac{\overline{G}_i \times Population_i}{\sum_{i=1}^{7} \overline{G}_i \times Population_i} \quad \text{.....(4.3)}$$

$$i = \#\,of\ municipalities\ 1,2,\text{.....},7$$

Where:

Θ_i was the relative sustainable capacity for a municipality i. (i = 1, 2, ..., 7)

G_i was the extent of sustainable capacity difference in a municipality i.

$Population_i$ was the population size of a municipality i.

Equation (4.3) provided the integral framework of a sustainable postwar reconstruction planning tool.

Donor procedures and practices (FW2). An understanding of the varied nature of the procedures and practices of donors is critical to studies in postwar reconstruction. Donors may set their own mandates, making unilateral decisions about the municipalities they work with and the beneficiary groups for which they provide support. A range of

humanitarian, national, political, financial, and religious interests are taken into consideration when a donor makes a decision about the types of projects to which, or through which aid channels, to provide support. The competition among donor agencies for infrastructure projects is typically unsystematic, resulting in what Barnes (1998) has described as a "duplication" of aid projects. The likely corollary of this duplication, in turn, is poor planning and implementation of reconstruction efforts. To avert this undesirable circumstance, donor agencies should endeavor to better understand the activities of rival agencies operating within the same community. Furthermore, complex bureaucratic procedures that may hinder the timely disbursement of funds should be avoided.

The absence of long-term donor support for projects is another major impediment to postwar reconstruction. For example, the outcome of the five years of reconstruction in Sierra Leone (2001-2006) was undesirable because the projects were primarily donor-driven, and many of them failed to address the actual needs of affected peoples. Moreover, there was a need for consultation and consensus among all stakeholders, including the local population, as to the nature of a project prior to its implementation.

Questionnaires were designed (see Appendix 6) to gather information on donor conditionality, priorities, and level of involvement (i.e., category of infrastructure, length of involvement, and requirements for funding). Donor representatives in the field, government national representatives, and representatives from beneficiary communities were referenced in order to determine the necessary response to the questionnaires.

The semantic differential technique was also used to aid this research assessment. A composite value, which is a representation of a particular donor, was obtained using the Normalized Euclidean Distance expression shown in equation 4.4.

$$\|x_i\| = \sqrt{\frac{x_{i,1}^2 + x_{i,2}^2 + x_{i,3}^2 + x_{i,4}^2 + \ldots + x_{i,n}^{\ 2}}{n}} \qquad \ldots\ldots(4.4)$$

where x_i is a vector of n components, $x_{i,1}, x_{i,2}, x_{i,3}, \ldots, x_{i,n}$. This equation computed the composite rating of a donor for a municipality, i, where $i = 1, 2, \ldots, 7$. The value of this variable will always fall within the seven-point Likert scale.

The Euclidean distance measure was used for its comparative effectiveness in addressing issues of redundancies of results when multiple experts were involved in analyzing a system independently. The normalized Euclidean distance methodology provided a better approach in addressing such limitations. The Hamming distance, however, proved better when comparing entities or characteristics from predefined baseline values of the same.

Current Infrastructure State (FW3). The scale of infrastructure destruction typically varied between municipalities under each of the infrastructure categories. An assessment of the current state of infrastructure facilities involved a visual inspection of the physical facilities in each infrastructure category, as noted in Table 4.1.

A survey questionnaire (shown in Appendix 7) describes what was needed in the assessment of infrastructure facilities that survived the war. Building inspectors were trained to make assessments of each facility in terms of three of the building components (roof structure, supporting walls, and foundation). The semantic differential technique was used to measure the perception of these inspectors in their evaluation of the extent of destruction. For this assessment, a building structure was subdivided into three subcomponents and the same adjective descriptors were used for each description of these three components, (i.e., Good-Bad). The inspection was entirely visual and inspectors made subjective judgments for each subcomponent in succession. The findings were compiled to provide a measure of the destruction level of these structures (similar equation to 4.3).

Government and National Priorities (FW4). For a number of reasons, funding for reconstruction in postwar developing countries has been perennially inadequate. First, donor agencies are usually hesitant to sponsor projects in countries where corruption is rife and where the ruling government has a record of poor governance. This scenario has been noted for Guinea-Bissau and Liberia (Grey-Johnson, 2006) as well as for Sierra Leone, where the international community inevitably recommended the formation of an anti-corruption commission to address the rampant misappropriation of public funds. For some municipalities in Kambia District, projects which were initially approved for funding did not receive any funds until it was nearly too late. There was widespread concern that the disbursement of funds for reconstruction did not align with budgetary

plans, and it became clear that weak national strategies and poor administrative and management policies were hampering the government's ability to administer reconstruction. In this reconstruction impact allocation model, FW4 offers insight into the major obstacles faced by governments; (appendix 8 outlines components used in the assessment: e.g., government reform, networks, resource utilization, etc.). The semantic differential technique was used to measure the responses of field experts in response to questions raised in the questionnaire. The calculated composite value provided a measure of standing for a host government in meeting national priorities.

Coordination Effectiveness (FW5). The purpose of proper coordination in reconstruction efforts is to identify areas of mutual interest and responsibility for all stakeholders in order to promote the most efficient and integrated utilization of human and financial resources. Agencies in the field must work in close consultation with governments in the municipalities (often tribal or ethnic) in order to properly address infrastructure issues. According to Cowen and Coyne (2005) this may include the following: the exchange of information regarding agencies' program activities; regulations and future plans; provision of integrated reconstruction programs for tribal governments; provision of training and technical assistance both for donor agencies and for the local population; collaboration in areas of overlapping responsibility; and coordination and integration of assistance for tribal governments.

Unfortunately, there was no central authority for the reconstruction areas involved in this study charged with establishing a unified framework to coordinate these initiatives or ensuring their relevancy and impact. This last framework outlines the barriers to coordination and provides a tool for measuring their effect on project execution among municipalities. Appendix 9 illustrates the characteristics of coordination effectiveness using the semantic differential technique discussed earlier.

In conclusion, Phase 1 involves an analysis of the five frameworks and provides methods of their evaluation in order to capture the varied and complex issues associated with postwar infrastructure reconstruction.

4.2 PHASE 2:

Integration of frameworks with fuzzy based rules. The five frameworks discussed in the previous section provide the basis for two other phases in the allocation of resources for infrastructure rebuilding in Kambia District. The outputs of the frameworks (numerical values) must be integrated to provide a holistic measure of impact under any given infrastructure category based on an interpretation of the framework values. This is the second crucial phase in the effective distribution of resources in postwar reconstruction.

Problems are encountered when experts are asked to make an interpretation of data outputs. This is because the values of these outputs are often so close that the expression "low destruction level," for example, is not clearly defined among devastated municipalities. There has also been a tendency to reason more in terms of linguistic expressions than in terms of the numerical values generated from assessments. Evidently, experts find it difficult to proportionately grasp the variation of numbers among different municipalities. And because the relationships among the different frameworks are complex, a "fuzzy approach" seems appropriate to account for the inherent vagueness and uncertainties involved.

The infrastructure allocation model presented in this study can only be meaningful or effective if it mimics the cognitive processes humans use to evaluate using linguistically "if-then" rules. According to Dubois and Prade (1996), if-then rules have been advocated as essential tools for expressing knowledge in fuzzy logic. Accordingly, the use of linguistic variables together with fuzzy if-then rules as in Zadeh (1975) provides a convenient way to reflect the views of experts involved in postwar reconstruction decision-making processes.

A fuzzy rule-based approach to reconstruction is based on verbally formulated rules overlapping throughout the process. These rules use numeric interpolation to handle complex non-linear relationships, and are formulated by experts.

Fuzzy Modeling. In modeling with fuzzy based rules, this research has adopted two distinct approaches. The first, which had comprised four stages, was the identification of the surface structure. This initial stage involved:

1.selecting relevant input and output variables';

2. choosing a specific type of fuzzy interference system;

3.determining the number of linguistic terms associated with each input and output variable; and

4.designing a series of "if-then" rules.

The four stages provided the systematic approach required to obtain a rule base that described the behavior of the situation using linguistic terms.

The second approach to the modeling process involved assigning meanings to the linguistic terms. This process is referred to as "identification of deep structure." It also determined the membership functions of each linguistic term. Three stages were involved in the identification of deep structure:

1.choosing an appropriate family of parameterized membership functions;

2.interviewing experts familiar with target systems in order to determine the parameters of the membership functions; and

3.refining the parameters in the membership functions (see Jang et al., 1997),

The experts were comprised of personnel drawn from groups of reconstruction stakeholders within Kambia District. This provided an advantage in terms of the engagement of those who would benefit from the identification and implementation of reconstruction efforts.

Selection of input and output variables. The input variables are the derived ratings of the different frameworks discussed earlier (Sustainable capacity- FW1, donor procedure and practices-FW2, current infrastructure State- FW3, government and national priorities- FW4, and coordination effectiveness- FW5).

The first step towards incorporating the diverse data obtained from the five different frameworks into a fuzzy model was the construction of membership functions. Each of the linguistic terms (e.g., minor destruction, low sustainability gap, moderate donor preference, etc.) was represented by a fuzzy set on the universal [0, 1] scale. The distinct points of each framework output were "fuzzified" and curves were aggregated. The selection of relevant membership functions that compressively defined the input and output variable was especially critical as it required the identification of the shapes of the membership functions for every variable over linguistic terms that were adopted by this

research. The inputs (the five FWs) were defined by five linguistic terms for FW1 (very low, low, medium, high, and very high), three for FW2 (minor, moderate, and major), three for FW3 and FW4 (minor, moderate, and high); another three for FW5 (poor, moderate, and good), and five for the output (Rate1, Rate2, Rate3, Rate, and Rate5). In order to accomplish the selection of appropriate membership functions, an extensive review of previous applicability of functions was conducted, combined with the relevant details from a course module taught by Professor Aminah Robbinson, University of Alberta (Civ E 680, 2006). Figures 4.3 through 5.7 show the final conclusion reached for identification of fuzzy numbers.

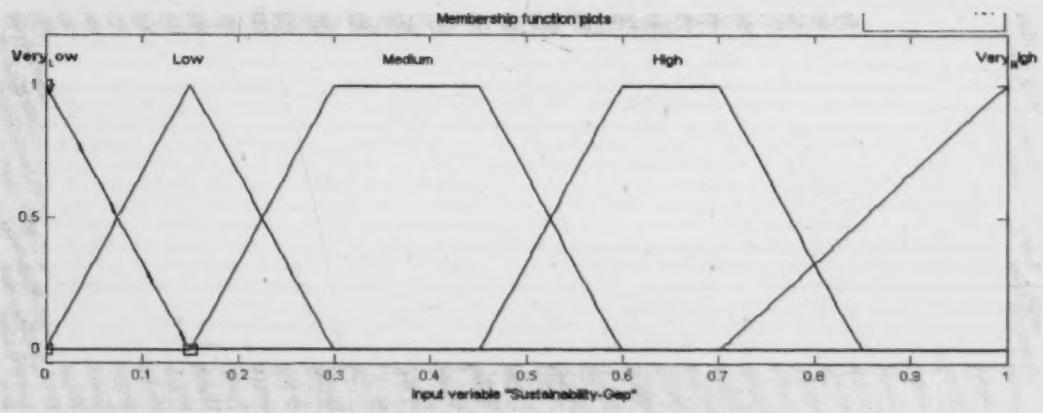

Figure 4.3: Linguistic variables for sustainability gap framework (FW1)

The identified fuzzy numbers for FW1 were as follows: Very low = {0.0; 0.15}; Low = {0.0, 0.15, 0.3}; Medium = {0.15, 0.3, 0.45, 0.6}; High = {0.45, 0.6, 0.7, 0.85}; and Very high = {0.7, 1.0}. These values (i.e., abscissa values) were used based on a 0 to 1 scale. The scale was chosen to reflect measures of human development index values. These index values were used in FW1 to define how the devastated municipalities' current situations deviated from those of a normal society in a Sub-Saharan Africa setting (i.e., on quality of life indicator values documented in the World Bank Report (2003)) along with expert knowledge used as labels for a categorical sustainable capacity gap scale.

For the remaining frameworks, FW2 – FW5, the semantic bipolar scales were used.

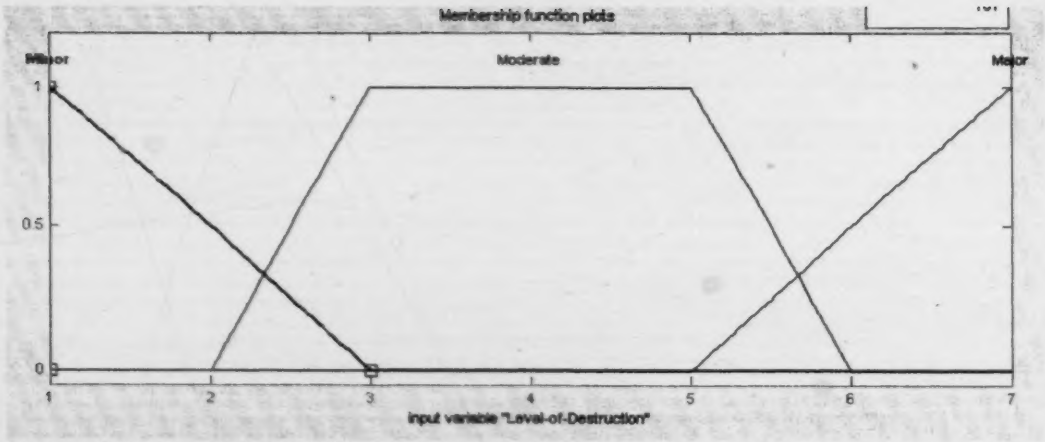

Figure 4.4: Linguistic variables for framework FW2

The values in the abscissa ranged from 1 to 7 (Figure 4.2). As opposed to FW2 values, the computation for the derivation of values for the variables was carried out using the semantic differential technique. The expression used (equation 4.3) to derive outputs for FW2 was aimed at arriving at a value that fell within the seven point Likert's scale. The interval values for the variables, Minor {0; 3}, Moderate {2; 3; 5; 6} and Major {5; 7}, defined the range of values within the fuzzy variable. In determining these, each expert was requested to identify a range for the existence of every framework factor drawing from their years of experience in the field. Mean values were used in cases where there were discrepancies in the assigned values.

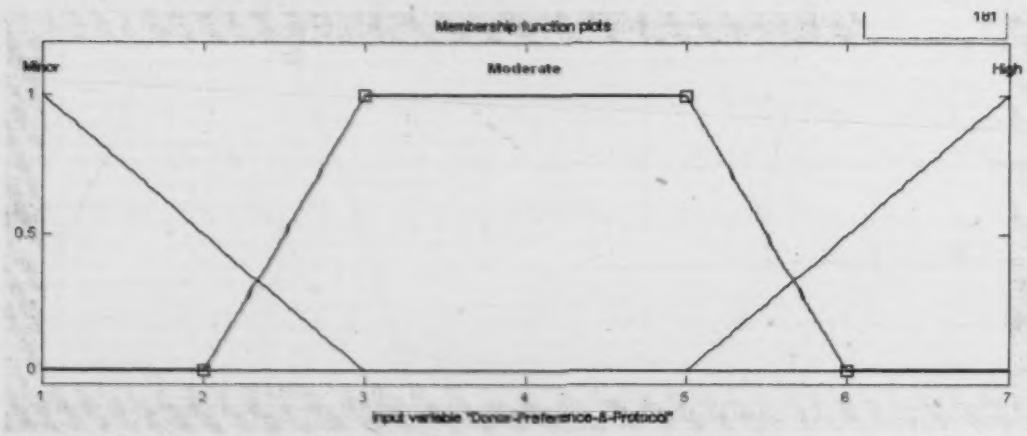

Figure 4.5: Linguistic variables for frameworks FW3 and FW4

The abscissa values in figure 4.5 follow similar reasoning to those presented in Figure 4.2.

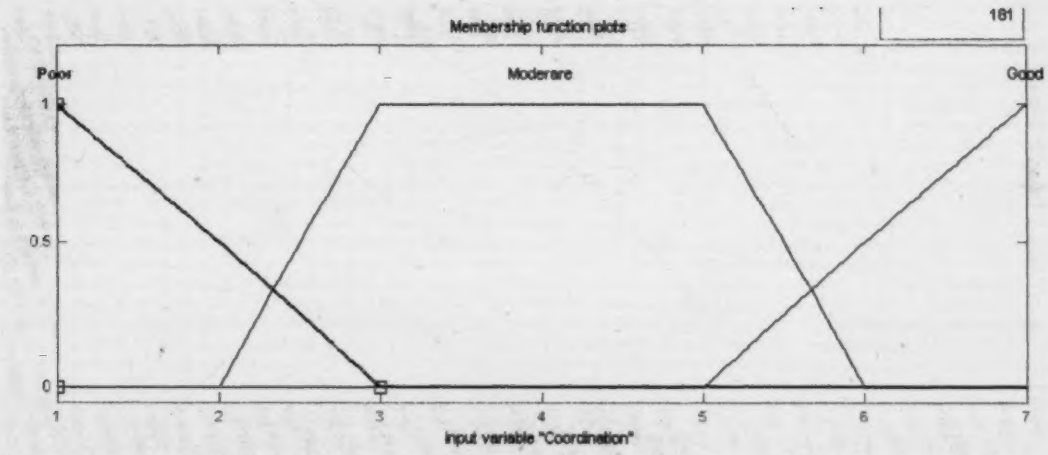

Figure 4.6: Linguistic variables for framework FW5

The abscissa values in figure 4.5 follow similar reasoning to those presented in Figure 4.2.

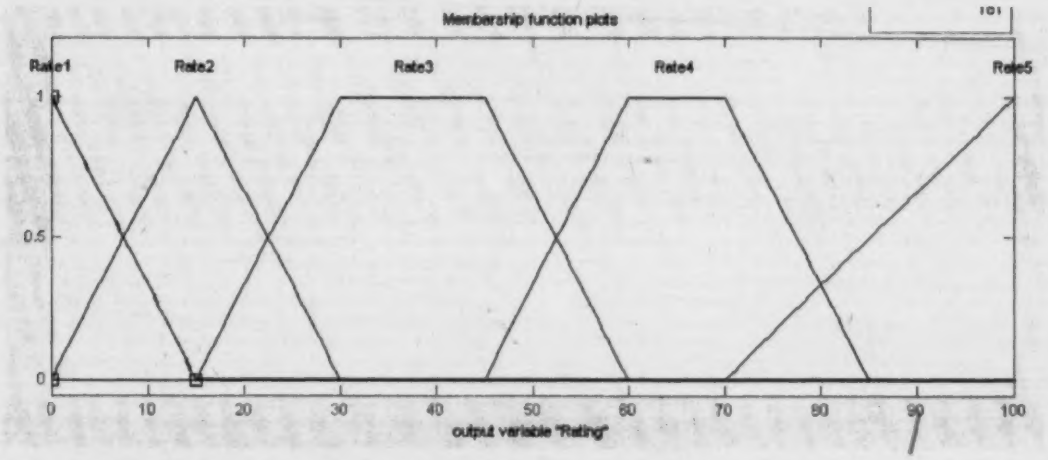

Figure 4.7: Membership functions assigned to output variables

The output membership functions were defined so as to provide an estimation of cumulative effects of the five frameworks on citizens in the devastated municipalities. This was perceived as an indication of the quality of life of these people. It was also reflective, in a holistic manner, of the human development index of municipalities. Instead of the 0 to 1 scale used in FW1, the percentage (0 – 100%) scale was adopted.

The interval values: Rate1 {0; 15}, Rate2 {0; 15; 30}, Rate3 {15; 30; 45; 60}, Rate4 {45; 60; 70; 85}, and Rate5 {70; 100} were used to cover the variables of the output. The ranges of values were also identified by experts who had extensive experience with development projects in postwar situations and who were familiar with the Kambia District demographics. Mean values were used in cases where there were discrepancies in the assigned values.

In writing if-then rules, one should be very careful to investigate each factor superlatively, relative to its contribution to the final model output, and prior to final adoption of the rule. In order to achieve this, this research has followed two basic steps. The first was to ask field experts how each framework influenced the output of the model. Second, experts were asked to provide possible combinations of frameworks that would have influenced the model output. These initial steps provided a useful guide for assessing the experts' responses in the evaluation of the rules proper. Appendix 10 provides these rules as defined by experts.

The rules are calculated using the Mamdani implication operator discussed in Chapter 2. However, not all of the rules had an equal influence on findings, so each rule was assigned a respective weight. An assessment of such rules by means of appropriate quality measures is self-evident in Prade et al. (1994), as it assumes an understanding of the semantic meaning of a fuzzy rule. In a more practical and holistic approach to meeting postwar reconstruction objectives, the author concluded that this impact-based reconstruction model provided a standardized approach, acceptable to all involved in any infrastructure project selection process, and in the most transparent manner possible.

4.3 PHASE 3:

Optimization / Allocation. The final phase of the methodology utilized three distinct components: Phase 2 output values, cost to reconstruct/rehabilitate facilities in municipalities, and constraints imposed by management. The constraints are subdivided into three subcomponents:

(1) Funding limitation by infrastructure category stipulated a total expenditure amount per infrastructure category which should not be exceeded.

(2) Interdependency of facilities stipulated that selection of particular projects automatically implied the selection of another for reconstruction. For example, provision of portable water had been investigated by organizations implementing projects in postwar Sierra Leone and was deemed essential in devastated municipalities. Currently, partners such as the United Nations Development Program (UNDP/Sierra Leone), CARE International, the Department of International Development, the United Kingdom DFID, and the GOSL have instituted a mandatory inclusion of a water component in some of their postwar reconstruction projects. The scenarios precipitating this requirement were based on donor representatives' experiences in the field. Education and health projects, for instance, fall under this category.

(3) Limitation on number of facilities for allocation to municipalities. These numbers should not exceed postwar numbers.

The outputs of the optimization/allocation model provide a measure of standing in terms of priority and an indicator of impact generated from reconstruction of infrastructure facilities. These values vary as infrastructure development advances in the municipalities. Computation of the values was necessary for each case of infrastructure funding. This third phase optimized the mix of number of facilities for reconstruction based on impact values, cost of reconstruction, and funding constraints.

CHAPTER FIVE

5. FINDINGS AND DISCUSSION

This fifth chapter presents the findings of a case study of one municipality's infrastructure reconstruction situation following a long and debilitating civil war in Sierra Leone. Efforts to rebuild are complex, and this research has explored them in-depth using an impact-based allocation model implemented in 3 phases during field work in May – June, 2007. These findings illustrate the methodology in a practical perceptive, according to the 3 phases.

The Support to Resettlement and Reintegration program (GOSL-UNDP joint project) began in 2001. This program has supported the reconstruction of conflict-affected municipalities in Sierra Leone by means of a community based multi-sectoral reconstruction program. The goal is to link emergency and development assistance in the restoration of an environment that will permit the resumption of peaceful and sustainable living conditions. The principal beneficiaries are citizens of the host communities. The strategy requirements are:

1. participatory and demand-driven micro projects designed and funded in response to community and/or group beneficiary initiatives;
2. community-based micro project approval and funding authority delegated to competent indigenous implementing partners in the area of implementation, consistent with environmental sustainability requirements;
3. multi-sectoral, gender-focused, and non-discriminatory beneficiaries treated equally in terms of eligibility for assistance; and
4. synergy developed with competent entities and other UN agencies aimed at taking maximum advantage of various implementation partners.

This program presented an opportunity to test this reconstruction impact based model, using the three phases of the model discussed in an earlier Chapter.

The research methodology focused on the involvement of experts in the field who were working towards the restoration of different infrastructure categories. These groups of experts from whom the relevant data were collected comprised a combination of personnel from non-governmental organizations, government ministries, donor

organizations, and affected municipalities. The experts provided advice about the selection of key criteria and their relative rankings relative to the municipalities. They also provided numerical values of the criteria relative to current quality of life in the municipalities, and made recommendations to their ideal values based on the Sub Saharan Africa benchmark.

5.1 PHASE 1

Seven focus groups, one for each infrastructure category, previously discussed, were used to participate in the analysis, and the factors outlined in Table 4.1 were referenced here. To provide a comprehensive presentation of the methodology, one infrastructure category will be selected and details of the step-by-step approach of the evaluation procedures for FW1 will be illustrated.

FW1. The education infrastructure category was used to explain the computational steps. Nine criteria indicators of this infrastructure category (see Table 5.1) were used in the evaluation process. Column 4 in the table illustrates the harmonized view of experts in the education group in classifying the criteria into two groups, "u" and "v."

Table 5.1: Criteria for an educational institution, notation, and classification

Criteria	Educational criteria	Notation	Classification
1	Economic condition of municipality	C1	u
2	Equitable compensation for staff	C2	u
3	Affordability of services	C3	u
4	Ethnicity and heterogeneity of citizens	C4	u
5	Educational policy coordination*	C5	v
6	Compensatory programs for staff	C6	u
7	Views of parents and stakeholders*	C7	v
8	Literacy rate	C8	u
9	Involvement of the education ministry	C9	u

* Unfavorable not to attain as well as to exceed the required level

The municipalities, numbered M1 to M7, and the criteria indicators, C1 to C9, were used in the AHP process.

The AHP Application. A pair-wise comparison was carried out by assigning criteria weights between 1 (equal importance) and 9 (absolutely more important) to the important criterion (Satay, 1980). The criteria are compared in pairs, with one criterion

awarded a score reflecting its relationship to the other criterion in the pair. That is, each pair of criteria is compared with regard to the next criteria. Those comparisons were verbalized by respondents in the study. For example, the question might be: "With regard to criterion C1, how much more important is C1 over C2 in M1 (or vice versa)?" A ratio scale between 1 and 9 was used (see Table 2.1) with a value of 1 indicating indifference and a value of 9 indicating very strong preference. Likewise, if criterion C1 was judged to be moderately more important than criterion C7, a score of 3 was given. A fundamental concept in evaluating the judgments was that the smaller or lesser element serves as the unit and the larger or greater one is estimated as a multiple of that unit. The reciprocal of this value was then assigned to the other criterion in the pair. This scale can be applied to the dimension of importance as well as to likeliness and preference (Harker, 1998). The results of this operation are presented in Table 5.2, which shows that criterion C2 is more important than criterion C1.

Table 5.2: Matrix of Pair-wise comparisons of Education criteria

Criterion	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1	1	1/2	2	1	2	1/2	3	1	1/2
C2	2	1	4	2	2	1	3	4	3
C3	1/2	1/4	1	1	2	1/2	2	3	1/2
C4	1	1/2	1	1	2	1	2	1	2
C5	1/2	1/2	1/2	1/2	1	1	2	2	1/2
C6	2	1	2	1	1	1	2	2	2
C7	1/3	1/3	1/2	1/2	1/2	1/2	1	1/2	1/3
C8	1	1/4	1/3	1	1/2	1/2	2	1	2
C9	2	1/3	2	1/2	2	1/2	3	1/2	1
TOTAL	**10 1/3**	**4 2/3**	**13 1/3**	**8 1/2**	**13**	**6 1/2**	**20**	**15**	**11 5/6**

The weights in Table 5.2 were then normalized by dividing each entry in a column by the sum of all the entries in that column such that they would add up to one. Following the normalization, the weights were averaged across the rows to give the total average weight for each criterion as shown in Table 5.3.

Table 5.3: Normalized pair-wise rating for selection criteria

Criterion	C1	C2	C3	C4	C5	C6	C7	C8	C9	Weight,($\overline{w}_i$)
C1	0.10	0.11	0.15	0.12	0.15	0.08	0.15	0.07	0.04	0.11
C2	0.19	0.21	0.30	0.24	0.15	0.15	0.15	0.27	0.25	0.21
C3	0.05	0.05	0.08	0.12	0.15	0.08	0.10	0.20	0.04	0.10
C4	0.10	0.11	0.08	0.12	0.15	0.15	0.10	0.07	0.17	0.12
C5	0.05	0.11	0.04	0.06	0.08	0.15	0.10	0.13	0.04	0.07
C6	0.19	0.21	0.15	0.12	0.08	0.15	0.10	0.13	0.17	0.15
C7	0.03	0.07	0.04	0.06	0.04	0.08	0.05	0.03	0.03	0.05
C8	0.10	0.05	0.03	0.12	0.04	0.08	0.10	0.07	0.17	0.08
C9	0.19	0.07	0.15	0.06	0.15	0.08	0.15	0.03	0.08	0.11
TOTAL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	

The next step was to perform the pair-wise comparison of the different municipalities within the selected district. This step attempted to quantify how well the municipalities satisfy each of the criteria. For each pairing of the municipalities within a criterion, the better municipality was awarded a rating between 1 (equally responsive) and 9 (absolutely better), while the other municipality was awarded a rating equal to the reciprocal of this value. The results for the assessment on how municipalities' value education based on a relative holistic rating of the education infrastructure category criteria are given in Table 5.4.

Table 5.4: Matrix of Pair-wise comparisons of alternative municipalities with respect to Education Infrastructure Category (E)

Municipality		M1	M2	M3	M4	M5	M6	M7
Mambolo -	M1	1	1	1	1/3	3	3	3
Samu -	M2	1	1	1	1/3	3	3	3
Gbinleh-Dixing -	M3	1	1	1	1/3	3	3	3
Magbema -	M4	3	3	3	1	5	5	5
Masungbala -	M5	1/3	1/3	1/3	1/5	1	1	1
Tonko Limba -	M6	1/3	1/3	1/3	1/5	1	1	1
Briamia -	M7	1/3	1/3	1/3	1/5	1	1	1
	Total	**7**	**7**	**7**	**2 3/5**	**17**	**17**	**17**

Each entry in this matrix (Table 5.4) records how well the municipalities (in rows) respond to "Education" when compared to the municipalities corresponding to its column. For instance, M2 responds better towards educational initiatives than M1. The ratings in these comparison matrices were normalized following the concept used in Table 5.3.

Table 5.5 was used in the determination of municipalities' infrastructure capacity (in the education sector). However, in order to produce an overall rating for each municipality, it was desirable to carryout the final step in the AHP, which was to combine the average normalized municipality ratings (Table 5.5) with the average normalized weights of criteria (Table 5.3). This is the extent to which the municipalities satisfy an infrastructure category and are weighted according to relative importance of the category, equation (4.1). Table 5.6 provides the results of this final step.

Table 5.5: Normalized pair-wise rating of alternative municipalities with respect to Education

Municipality	M1	M2	M3	M4	M5	M6	M7	Weight, $(\overline{w}_i)$
M1	0.063	0.046	0.080	0.056	0.041	0.100	0.085	0.067
M2	0.189	0.139	0.133	0.112	0.166	0.200	0.213	0.165
M3	0.316	0.417	0.400	0.449	0.414	0.267	0.298	0.366
M4	0.253	0.278	0.200	0.225	0.248	0.200	0.213	0.231
M5	0.126	0.069	0.080	0.075	0.083	0.133	0.128	0.099
M6	0.021	0.023	0.050	0.037	0.021	0.033	0.021	0.030
M7	0.032	0.028	0.057	0.045	0.028	0.067	0.043	0.043
Total	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 5.6: Average normalized ratings of municipalities with respect to each category of infrastructure $(\overline{w}_{c,i})$

	Infrastructure Category Weights $(\overline{w}_{c,i})$						
Municipality	E	H	W/S	T	S/S	A	SS/R
M1	0.067	0.050	0.160	0.103	0.059	0.041	0.043
M2	0.165	0.117	0.104	0.163	0.098	0.161	0.151
M3	0.366	0.344	0.345	0.251	0.354	0.368	0.365
M4	0.231	0.252	0.246	0.365	0.250	0.251	0.256
M5	0.099	0.163	0.030	0.058	0.169	0.060	0.093
M6	0.030	0.043	0.070	0.025	0.041	0.094	0.028
M7	0.043	0.030	0.046	0.035	0.029	0.026	0.062

Where

"c" is the category of infrastructure facility

The results clearly show that municipalities 3 and 4 respond highly in satisfying the overall criteria for education infrastructure facilities.

Hamming Distance Application. The next stage of the analysis was the determination of the gap created by war destruction in the infrastructure categories referencing a Sub-Saharan Africa benchmark. The concepts of Hamming Distance and fuzzy set theory were utilized. Table 5.7 shows the values of the ideal criteria in the infrastructure categories, and Table 5.8 outlines the current status or values of the criteria in the respective municipalities. The ideal values were extracted from the Human Development Report (UNDP, 2003) and were defined by experts in the field working in different infrastructure categories.

Table 5.7: Baseline or ideal levels of infrastructure criteria categories

	Desired Level (μ^I)						
Criteria*	E	H	W/S	T	S/S	A	SS/R
C1	0.6	0.6	0.6	0.6	0.6	0.6	0.6
C2	0.5	0.5	0.5	0.5	0.5	0.5	0.5
C3	0.7	0.7	0.7	0.7	0.8	0.6	0.6
C4	0.45	0.7	0.6	0.7	0.6	0.7	0.7
C5	0.48	0.8	0.7			0.6	0.6
C6	0.5	0.6					
C7	0.6						
C8	0.5						
C9	0.7						

**criteria under an infrastructure category follow the sequence in Table 6.1.*

In establishing the current numerical values of the criteria under an infrastructure category (Table 4.1), seven focus groups of experts each representing an infrastructure category were involved. Based on the group experience with the infrastructure category in the district, numerical values that are representative of current situation in the municipalities were provided. The resulting values are illustrated in Table 5.8 (i.e., current levels of infrastructure criteria categories).

The sustainability capacity, based on the gap existing between values for a normal Sub-Saharan Africa bench mark and the current situational values for each municipality, is obtained using the Hamming Distance expression (equation 4.1), including current criteria values of municipalities (Table 5.8) and the ideal values (Table 5.7).

Table 5.8: Current levels of infrastructure criteria categories

E	Current level (μ_i^M)						
Criteria*	M1	M2	M3	M4	M5	M6	M7
C1	0.1	0.15	0.2	0.4	0.2	0.25	0.2
C2	0.2	0.2	0.3	0.3	0.3	0.2	0.3
C3	0.4	0.3	0.2	0.35	0.2	0.3	0.2
C4	0.4	0.25	0.3	0.35	0.3	0.2	0.3
C5	0.4	0.3	0.35	0.25	0.2	0.3	0.2
C6	0.4	0.3	0.2	0.3	0.2	0.2	0.2
C7	0.3	0.35	0.3	0.3	0.25	0.15	0.2
C8	0.2	0.15	0.2	0.4	0.3	0.2	0.2
C9	0.2	0.2	0.3	0.4	0.2	0.2	0.3

H	Current level (μ_i^M)						
Criteria*	M1	M2	M3	M4	M5	M6	M7
C1	0.3	0.3	0.2	0.4	0.2	0.3	0.3
C2	0.1	0.1	0.4	0.3	0.2	0.3	0.3
C3	0.3	0.2	0.3	0.4	0.3	0.2	0.2
C4	0.4	0.3	0.4	0.4	0.3	0.3	0.2
C5	0.4	0.3	0.3	0.3	0.2	0.4	0.3
C6	0.3	0.3	0.2	0.4	0.3	0.2	0.2

W/S	Current level (μ_i^M)						
Criteria*	M1	M2	M3	M4	M5	M6	M7
C1	0.2	0.2	0.2	0.4	0.3	0.3	0.2
C2	0.3	0.3	0.4	0.4	0.3	0.3	0.2
C3	0.3	0.3	0.2	0.3	0.2	0.2	0.3
C4	0.3	0.3	0.3	0.4	0.3	0.2	0.2
C5	0.3	0.3	0.3	0.4	0.2	0.3	0.2

T	Current level (μ_i^M)						
Criteria*	M1	M2	M3	M4	M5	M6	M7
C1	0.2	0.2	0.2	0.4	0.2	0.2	0.2
C2	0.3	0.2	0.2	0.3	0.2	0.2	0.2
C3	0.3	0.3	0.2	0.3	0.3	0.2	0.2
C4	0.3	0.2	0.3	0.4	0.2	0.3	0.3

S/S	Current level (μ_i^M)						
Criteria*	M1	M2	M3	M4	M5	M6	M7
C1	0.3	0.3	0.3	0.5	0.3	0.3	0.4
C2	0.3	0.2	0.4	0.3	0.3	0.3	0.3
C3	0.3	0.2	0.2	0.4	0.2	0.3	0.3
C4	0.4	0.4	0.3	0.5	0.3	0.2	0.3

A	Current level (μ_i^M)						
Criteria*	M1	M2	M3	M4	M5	M6	M7
C1	0.4	0.4	0.3	0.4	0.3	0.3	0.3
C2	0.3	0.3	0.2	0.4	0.3	0.3	0.3
C3	0.4	0.3	0.3	0.4	0.3	0.3	0.2
C4	0.4	0.3	0.3	0.5	0.2	0.3	0.3
C5	0.3	0.3	0.3	0.4	0.3	0.4	0.3

SS/R	Current level (μ_i^M)						
Criteria*	M1	M2	M3	M4	M5	M6	M7
C1	0.3	0.3	0.3	0.4	0.3	0.2	0.2
C2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
C3	0.2	0.2	0.2	0.3	0.2	0.2	0.2
C4	0.2	0.2	0.2	0.3	0.2	0.2	0.2
C5	0.3	0.3	0.2	0.3	0.2	0.2	0.3

**criteria under an infrastructure category follow the sequence in Table 4.1*

Working through the computation (equation 4.1) showed results in the derivation of the gap values for the municipalities and is illustrated in Table 5.9.

Table 5.9: Overall infrastructure criteria gap in municipalities

	Gap (G_i)						
Municipality	E	H	W/S	T	S/S	A	SS/R
M1	0.993	1.011	0.950	0.656	0.481	0.308	0.375
M2	0.985	0.596	0.287	0.688	0.456	0.319	0.375
M3	0.993	0.972	0.861	0.672	0.456	0.319	0.375
M4	1.816	1.436	0.836	1.139	0.887	1.041	1.500
M5	0.292	0.328	0.327	0.253	0.444	0.457	0.375
M6	0.294	0.318	0.980	0.247	0.444	0.375	0.375
M7	0.282	0.309	0.360	0.305	0.444	0.363	0.375

Table 5.9 provides a snapshot of the computed infrastructure gap which defined a measure of the assessed holistic deficiencies of municipalities in an infrastructure category. The larger the absolute value of G_i, the farther the municipality is from ideal conditions. The trends of the calculated deviations from ideal conditions did not show much difference among some municipalities (e.g M1, M2 & M3, and M5, M6, & M7 in the education category). In general, the G_i is rated as "high". However, the categories "security and safety" as well as "administration" signaled improvement based on their values in the respective municipalities.

In order to provide a measure of capacity which also indicates the extent of need of municipalities in each infrastructure category, the inverse of G_i was used. This capacity/need measure is represented by $\overline{G_i}$ as shown by equation

Table 5.10: Measure of infrastructure need in municipalities

	Need Measure ($\overline{G_i} = 1/G_i$)						
Municipality	E	H	W/S	T	S/S	A	SS/R
M1	1.013	0.989	1.053	1.524	2.079	3.247	2.667
M2	1.024	1.678	3.484	1.455	2.193	3.135	2.667
M3	1.012	1.029	1.161	1.488	2.193	3.135	2.667
M4	0.551	0.696	1.196	0.878	1.127	0.961	0.667
M5	3.425	3.049	3.058	3.953	2.252	2.188	2.667
M6	3.401	3.145	1.020	4.049	2.252	2.667	2.667
M7	3.546	3.236	2.778	3.279	2.252	2.755	2.667

Incorporating population size of municipalities. Incorporating population imbalances using equation 4.3 rendered the results in Table 5.11. The approach takes into consideration the effect of the size of the population in municipalities. This was critical since many factors influence the return of displaced citizens or refugees to communities from which they had fled as a consequence of the war.

Many, in fact, have found current living conditions in new locations more adequate than the pre-war situation, but others may view the situation differently. As such, current population sizes of municipalities play a significant role in the allocation of funds for reconstruction.

Table 5.11: Relative rating of municipalities in the infrastructure categories

Mi	$\Theta_{c,i}$						
	E	H	W/S	T	S/S	A	SS/R
M1	0.2935	0.2713	0.2505	0.3260	0.3873	0.4353	0.4172
M2	0.1262	0.1964	0.3539	0.1327	0.1743	0.1791	0.1780
M3	0.1488	0.1429	0.1401	0.1615	0.2071	0.2128	0.2115
M4	0.0561	0.0667	0.0889	0.0657	0.0734	0.0449	0.0365
M5	0.1080	0.0905	0.0788	0.0913	0.0454	0.0316	0.0451
M6	0.2110	0.1839	0.0518	0.1845	0.0895	0.0761	0.0889
M7	0.0563	0.0483	0.0360	0.0383	0.0229	0.0201	0.0227

Based on the numerical values (in Table 5.11), the bigger the number, the greater the need and the higher the capacity for sustainability of rebuilt infrastructure of municipality for the infrastructure category.

FW2. Donors' impact on postwar reconstruction initiatives was evaluated in terms of their estimated influence or contribution to each infrastructure category, and these contributions were assessed based on the questions posed in Appendix 6. A representative score for the question was obtained based on a series of situational pre-assessed fundamentals about the question. The semantic differential technique was used to give a total score for each category in the seven municipalities. The score showed the extent to which a given infrastructure category was relevant to the selection and allocation of facilities for reconstruction in devastated communities.

The experts chosen to take part in this study were drawn from six different donor implementing organizations (UNDP, DFID, ORCHA, NaCSA, Action Aid, and Caritas Sierra Leone). Government executives administered operations of the categories (i.e., teachers for the education category, doctors for health, etc.) in the district and the local decision-makers in the municipalities (i.e., paramount chiefs and municipal sectional heads) performed administrative responsibilities. The criteria used in the selection of sample participants was based on position within the establishment, qualifications, number of years working in the district, and age. Their selection was also based on the respondent's willingness to participate in the research and his or her frankness in answering the questions.

The opinion of experts with respect to the evaluation criteria was obtained using a questionnaire (Appendix 6). For each criterion, the respondent was asked to assign his or her perceived importance in the form of marks in a Likert scale from 1 to 7.
The weighting for each of the chosen criteria is illustrated in Table 5.12; (for experts, see Appendix 6).

The rating was a representative measure of the four criteria under each of the infrastructure categories. The semantic differential formula was used to assess these values. It provided an indication of the donor's overall funding behavior in the reconstruction process. The values inform better understanding and knowledge of the core concept of recent and ongoing recovery programmes sponsored by the donor communities.

The procedures and practices of each donor are ideal to the organization, and it is regarded as appropriate to carry out evaluations for each donor separately. Although this research work has sought inputs to almost all of the donor organizations and the affiliated NGOs discussed in Appendices 2 and 3 the UNDP, which leads the Sierra Leone reconstruction process, is used to portray findings for this study (see Table 5.12).

FW3. In evaluating the current infrastructure state in Kambia District, three engineers and one superintendent of works were trained to conduct an assessment of the physical infrastructure. The details in Appendix 7 were used to investigate three components of each building (foundation, supporting structure, and roof).

Table 5.13 provides the assessed values of the current status of infrastructure facilities. The estimated values provide an indication of the extent of the damage suffered by the facility and the amount of work required to raise it to an acceptable level. The results have shown that most facilities are in a bad state and require complete reconstruction. The road network is in deplorable condition and many are no longer passable because of destruction of bridges and culverts, or due to the riverine nature of some areas.

Table 5.12: Evaluation data for donor (UNDP) procedures and practices and resulting ratings

	M1							M2							M3							M4						
	Infrastructure Categories																											
Criteria	E	H	W/S	T	S/S	A	SS/R	E	H	W/S	T	S/S	A	SS/R	E	H	W/S	T	S/S	A	SS/R	E	H	W/S	T	S/S	A	SS/R
D-C1	3	3	3	2	3	4	6	2	2	3	4	3	4	5	2	2	2	3	3	4	4	3	3	2	3	3	4	6
D-C2	4	4	3	3	3	4	5	3	2	3	4	4	3	6	2	2	4	4	4	4	5	4	3	3	4	4	4	5
D-C3	5	5	4	4	4	3	6	3	3	2	4	3	4	5	3	3	3	3	3	4	5	3	4	3	4	3	4	6
D-C4	6	5	3	5	5	6	7	5	6	6	5	5	5	7	3	3	3	5	4	4	5	4	5	5	5	6	5	7
Rating	**4.6**	**4.3**	**3.3**	**3.7**	**3.8**	**4.4**	**6.0**	**3.4**	**3.6**	**3.8**	**4.3**	**3.8**	**4.1**	**5.8**	**2.6**	**2.8**	**2.6**	**3.8**	**3.5**	**4.0**	**4.5**	**3.5**	**3.8**	**3.4**	**4.1**	**4.2**	**4.3**	**6.0**

Criteria	**M5**							**M6**							**M7**						
D-C1	2	3	2	3	4	4	6	2	4	3	4	3	4	5	3	2	3	4	3	4	5
D-C2	4	3	3	3	3	4	6	3	2	3	4	4	3	6	2	2	3	4	4	3	6
D-C3	4	5	4	4	4	3	5	3	3	2	4	3	4	5	3	3	2	4	3	4	5
D-C4	5	5	3	4	5	6	7	5	6	4	5	5	4	7	4	6	6	5	5	5	7
Rating	**3.9**	**4.1**	**3.1**	**3.5**	**4.1**	**4.4**	**6.0**	**3.4**	**4.0**	**3.1**	**4.3**	**3.8**	**3.8**	**5.8**	**3.1**	**3.6**	**3.8**	**4.3**	**3.8**	**4.1**	**5.8**

Table 5.13: Assessed conditions of the physical infrastructure facilities

Building Component	M1							M2							M3							M4						
	Infrastructure Categories																											
	E	H	W/S	T	S/S	A	SS/R	E	H	W/S	T	S/S	A	SS/R	E	H	W/S	T	S/S	A	SS/R	E	H	W/S	T	S/S	A	SS/R
Foundation	2	3	3		2	3	5	3	2	4		3	3	5	2	2	2		3	4	3	4	3	2		2	5	6
Walls	5	4	5		3	3	3	4	2	3		4	5	6	4	3	2		3	5	4	5	4	3		4	6	7
Roof	6	6	7		5	5	4	7	5	6		5	7	7	5	6	5		4	7	5	6	5	6		7	6	7
Road Cond.				4							5							4							6			
Rating	**4.7**	**4.5**	**5.3**	**4.0**	**3.6**	**3.8**	**4.1**	**5.0**	**3.3**	**4.5**	**5.0**	**4.1**	**5.3**	**6.1**	**3.9**	**4.0**	**3.2**	**4.0**	**3.4**	**5.5**	**4.1**	**5.1**	**4.1**	**3.6**	**6.0**	**4.8**	**5.7**	**6.7**

Component	M5							M6							M7						
Foundation	4	3	3		4	3	5	2	4	3		3	4	5	4	2	4		3	5	4
Walls	5	3	4		5	4	6	3	2	3		4	3	6	5	4	5		5	6	5
Roof	6	7	6		7	5	7	3	3	2		3	4	5	7	6	7		6	7	7
Road Cond.				5							6							5			
Rating	**5.1**	**4.7**	**4.5**	**5.0**	**5.5**	**4.1**	**6.1**	**2.7**	**3.1**	**2.7**	**6.0**	**3.4**	**3.7**	**5.4**	**5.5**	**4.3**	**5.5**	**5.0**	**4.8**	**6.1**	**5.5**

FW4. The effects of Sierra Leone national priorities on the selection of infrastructure for reconstruction in municipalities are evaluated in terms of their estimated influence or contribution to each infrastructure category. These contributions are assessed using the questions posed in Appendix 8. A representative score for the question was obtained based on a series of situational pre-assessed fundamentals about each question, and the semantic differential technique was used to provide a total score for the category under each of the seven municipalities. The score reflected how relevant a given infrastructure category was to the selection and allocation of facilities for reconstruction in devastated communities.

The same group of experts was used as in the assessment of FW2. Their opinions with respect to the evaluation criteria were obtained using the questionnaire. As discussed above, for each criterion, each respondent was asked to assign his or her perceived importance using a Likert scale from 1 to 7. The assigned values or weights for each criterion are illustrated in Table 5.14.

The values provide an indication of the strength of government and national priorities in postwar Sierra Leone reconstruction initiatives. The numerical values showed a preference toward security and safety, education, health, and water and sanitation. Social services and recreation were lowest in terms of priority in the district for all municipalities.

Table 5.14: Criteria values estimation of government and national priorities

Criteria	M1							M2							M3							M4						
	Infrastructure Categories																											
	E	H	W/S	T	S/S	A	SS/R	E	H	W/S	T	S/S	A	SS/R	E	H	W/S	T	S/S	A	SS/R	E	H	W/S	T	S/S	A	SS/R
G-C1	5	4	5	5	3	3	6	4	3	5	4	3	4	6	3	3	5	5	3	4	6	3	3	5	5	3	4	6
G-C2	4	4	5	4	3	4	6	4	3	4	5	3	4	6	3	3	4	3	4	3	5	4	3	5	3	4	5	6
G-C3	5	5	5	5	5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	6	5	5	5	5	5	5	6
G-C4	3	2	5	5	2	3	5	3	3	5	4	2	3	7	3	3	4	4	4	3	5	3	4	5	4	5	3	6
G-C5	3	3	4	4	2	3	5	4	4	5	6	2	3	6	4	4	5	5	3	3	6	3	4	5	4	3	4	5
G-C6	2	2	4	4	2	5	6	2	2	3	4	2	5	6	2	3	4	5	2	4	5	3	3	5	4	3	5	6
G-C7	3	3	5	5	3	5	6	3	3	4	4	3	5	6	3	2	4	5	2	4	6	2	2	4	5	3	4	6
Rating	**3.7**	**3.6**	**4.7**	**4.6**	**3.0**	**4.1**	**5.7**	**3.7**	**3.4**	**4.5**	**4.6**	**3.0**	**4.2**	**6.0**	**3.4**	**3.4**	**4.5**	**4.6**	**3.4**	**3.8**	**5.6**	**3.4**	**3.6**	**4.9**	**4.3**	**3.8**	**4.3**	**5.9**

Criteria	M5							M6							M7						
G-C1	3	3	4	5	4	5	6	2	4	3	4	3	4	5	3	2	3	4	3	4	5
G-C2	3	3	4	4	3	4	6	3	2	3	4	4	3	6	2	2	3	4	3	4	6
G-C3	3	3	4	5	3	4	5	3	3	2	4	3	4	5	3	3	2	5	3	4	6
G-C4	3	3	5	4	2	4	7	4	3	4	5	3	4	7	3	3	4	5	3	4	7
G-C5	2	2	4	5	2	4	7	3	3	4	5	2	4	6	3	3	4	4	2	4	6
G-C6	3	3	4	4	3	3	6	3	3	3	4	2	3	6	3	3	3	5	3	4	7
G-C7	3	3	4	5	3	4	6	3	3	4	5	3	4	6	3	3	4	5	2	4	6
Rating	**2.9**	**2.9**	**4.2**	**4.6**	**2.9**	**4.0**	**5.8**	**3.1**	**3.1**	**3.4**	**4.5**	**2.9**	**3.7**	**5.9**	**2.8**	**2.8**	**3.4**	**4.6**	**2.8**	**4.0**	**6.2**

FW5. This framework computed the coordination enhancing mechanisms that aid effective transformation of potential situations of conflict into situations of cooperation. This involves coordinating a municipality population and all other stakeholders around a set of conjectures aligning with the aims of reconstruction. These coordination elements were assessed using the questions posed in Appendix 9. A representative score for each question was obtained based on a series of situational pre-assessed fundamentals about the question. The semantic differential technique was used to give a total score for the category under each of the seven municipalities. The score shows how relevant a given infrastructure category is to the selection and allocation of facilities for reconstruction in devastated communities.

Again, the same group of experts was used as in the assessment of FW2. As previously discussed, for each criterion, a respondent was asked to assign his or her perceived importance in the form of a grading on a Likert scale from 1 to 7. The assigned values for each criterion are illustrated in Table 5.15. The results indicate that coordination is substantial in all communities when it comes to security and safety. The numerical values also indicate that there is quite a reasonable amount of coordination in the fields of health, education, and water and sanitation.

Table 5.15: Coordination effectiveness in municipalities for projects in the categories of infrastructure

Criteria	M1							M2							M3							M4						
	Infrastructure Categories																											
	E	H	W/S	T	S/S	A	SS/R	E	H	W/S	T	S/S	A	SS/R	E	H	W/S	T	S/S	A	SS/R	E	H	W/S	T	S/S	A	SS/R
CO-C1	4	4	4	5	3	2	5	4	3	4	4	3	4	6	3	3	5	5	3	4	6	3	4	5	5	3	4	6
CO-C2	3	4	5	5	3	4	5	4	3	4	5	3	4	6	3	3	4	3	4	3	5	4	3	4	5	3	4	6
CO-C3	5	5	5	5	4	3	6	3	4	5	5	3	3	5	4	3	5	5	3	4	5	3	4	5	6	2	4	5
CO-C4	3	2	5	5	2	3	5	3	3	5	4	2	3	7	3	3	4	5	4	3	5	3	4	5	5	5	3	6
CO-C5	4	3	4	4	2	3	5	4	4	5	6	2	3	6	4	4	5	5	3	3	6	3	4	5	6	3	4	5
CO-C6	3	2	4	5	2	4	6	2	2	3	4	2	5	6	2	3	4	5	2	4	5	4	3	5	5	3	4	6
Rating	**3.7**	**3.5**	**4.5**	**4.9**	**2.8**	**3.2**	**5.4**	**3.4**	**3.2**	**4.4**	**4.7**	**2.6**	**3.7**	**6.0**	**3.2**	**3.2**	**4.5**	**4.7**	**3.2**	**3.5**	**5.4**	**3.4**	**3.7**	**4.9**	**5.4**	**3.3**	**3.9**	**5.7**

Criteria	M5							M6							M7						
CO-C1	4	3	4	5	3	5	6	2	4	3	4	3	4	5	4	3	3	4	3	4	5
CO-C2	3	3	4	4	3	4	6	3	2	3	4	4	3	6	3	2	3	4	3	4	5
CO-C3	3	3	4	5	3	4	5	3	3	2	4	3	4	5	3	3	4	5	3	4	6
CO-C4	3	3	5	4	2	4	7	4	3	4	5	3	4	7	3	2	4	5	3	4	7
CO-C5	2	2	4	5	2	4	7	3	3	4	5	2	4	6	3	3	4	5	2	4	6
CO-C6	3	3	4	4	3	3	6	3	3	3	4	2	3	6	2	3	3	5	3	4	5
Rating	**3.1**	**2.9**	**4.2**	**4.5**	**2.7**	**4.0**	**6.2**	**3.1**	**3.1**	**3.2**	**4.3**	**2.9**	**3.7**	**5.9**	**3.1**	**2.7**	**3.5**	**4.7**	**2.7**	**4.0**	**5.7**

In conclusion, ratings of municipalities in the categories of infrastructure for the five frameworks follow.

The sustainability capacity (FW1) went through two stages of evaluation (using Hamming Distance technique followed by the integration of population size of municipalities). The adoption of Analytic Hierarchy Process and Hamming Distance technique produced results (Table 5.9) of measure of gap of sustainability (referencing values for stable society with Sub-Saharan Africa bench marks). In the education category of infrastructure, M3 showed the highest relative capacity value (0.352) to sustain built educational facilities. It should be noted, however, that the smaller the value (Gap), the greater the capacity for sustainability. In the remaining categories of infrastructure, M4 portrayed the lowest gap values (health = 0.492, water & sanitation = 0.308, transportation = 0.596, security & safety = 0.193, administration = 0.149, and social services & recreation = 0.508). M4 was followed by M5 but for social services & recreation where M6 slightly led with a value of 0.0624.

The results of incorporation of population size to the inverse of the numerical values of gap measure showed M1, M6, and M2 leading in sustaining education infrastructure with values 0.2935, 0.2110, and 0.1488 (Table 6.11) respectively. The trend in education sustainability is followed by M3 and M5 with 0.1262 and 0.1080 respectively. The other municipalities do not differ markedly, (values fall within 0.054 to 0.057). In the health infrastructure category, M1 surfaced with highest relative rating for sustainability with value 0.2713. M2 and M6 came closer to M1 with values 0.1964 and 0.1839 respectively. The relative ratings for the other municipalities were close to each other's value with a range falling within the values 0.04 and 0.09. The framework results also portrayed similar variation of values of capacity ratings for the categories of water and sanitation, roads (i.e., transportation), security and safety, and administration.

The framework output values should be looked upon as an index measure that will aide decision makers in postwar reconstruction of facilities that enhance the quality of life of citizens. These values indicate a measure of comparison between/among municipalities in the 7 categories of infrastructure used in this study. The values are part of the inputs to the integration model illustrated in Phase 2.

In donor procedures and practices (FW 2), the results of the framework suggest that donors tend to support projects related to water & sanitation, transportation (road rehabilitation), and security & safety for M1. Donors were least concerned with the areas of social services & recreation as noted by the values manifested in these municipalities. Education, health, water & sanitation, and security & safety were donor concerns for M2. Similar findings are noted for M3 and M4. Values indicated that for M5, donors are likely oriented to support water & sanitation, transportation (roads), and education projects. In M6, there is strong support for water & sanitation, education, security & safety, and administration. M7 is highly favored for education, health, and security & safety project initiatives.

The infrastructure current situation (FW3) analyses illustrated water & sanitation, education, and health categories as prominent in devastation in M1. Values for M2 indicate social services & recreation, administration, transportation, education, and water and sanitation categories of infrastructure are in poor condition. Similarly, findings for M3 indicated social services & recreation, transportation, health, and education were favored; M4 indicated social services & recreation, transportation, administration, education, security & safety, and health; M5 illustrated social services & recreation, security & safety, education, transport, health, and water and sanitation; M6 reported transportation, social services & recreation, and administration; and M7 results indicated security & safety, education, social services & recreation, water & sanitation, and transportation. The order or presentation of these categories of infrastructure illustrates the magnitude of devastation in descending order.

In the government and national priorities framework (FW4), output results (Table 5.14) illustrate security & safety as highest on the government list of priorities for municipalities. In the Kambia District headquarter town, M4, the value for security & safety was not highest rated, probably because there already existed good security structures and control mechanisms. Health and education were next in order of priorities to the Sierra Leone government for the municipalities. It can be noted from the findings (Table 5.14) that social services & recreation failed to capture the interest of government. Administration, in the establishment of municipality civil authority and government

administrative structures, showed a slight significance followed by road construction (i.e., transportation).

A secure base is seen by government as very important to attract donor attention for assistance in municipalities. It provides the basis for development as investors are attracted to places that are safe and secure. The return of those who fled the war is enhanced by the security & safety situation in the municipalities. Health and education provisions are seen by government as key contributing factors to improving quality of life. As one Sierra Leone government officer commented, "an education oriented municipality does not provide a recruiting site for rebels."

The coordination effectiveness framework (FW5) provides outputs that indicate the infrastructure facility measure of commonalities among stakeholders, including beneficiary groups. This framework represents the "meeting of the minds" of postwar reconstruction stakeholders. The results (Table 5.15) illustrate that all stakeholders worked with common objectives for the achievement of security and safety in all municipalities. This category maintained the lead in ratings across the municipalities. In relation to the other infrastructure categories, data in Table 5.15 indicate the following:

- M1 showed favorable indications for administration, education, and health facilities;
- M2 indicated health, education, and administration;
- M3 indicated education, health, and administration;
- M4 indicated education, health, and administration;
- M5 indicated health and education;
- M6 reported education, health, water & sanitation, and administration; and
- M7 indicated health, education, and water & sanitation.

Education and health facilities as discussed earlier were favorably accepted by all stakeholders. Administration, which seems to have a rating similar to education and health, is the institution that aids the preservation of traditional values in municipalities. Citizens in Kambia District municipalities reported a strong indication for re-establishment of traditional authorities.

5.2 PHASE 2

Integrating the Frameworks (FWs). The integrated effect of the five key elements (i.e., capacity of municipalities to sustain reconstructed facilities, donor procedures and practices, current infrastructure State, government and national priorities, and coordination effectiveness) to the selection of municipalities and infrastructure facilities for reconstruction using fuzzy rules was the focus of this second phase. The nature of the relationships based on the rules was predefined by experts (see Appendix 10). The interpretation of fuzzy rules dictated the way they should be combined (Dubois and Prade, 1996), and the relationships among the rules were significant based on the strength of the correlation.

The output values of the frameworks are so close that it is not feasible to make a clear distinction or interpretation of the numbers based on their numerical values. An effective integration based on fuzzy variables and rules has proved convenient for experts seeking to adequately distinguish and meaningfully interpret these values.

Table 5.16 illustrates the output values of the five frameworks. As can be seen, the difference in numerical values among the municipalities for any infrastructure category is minimal. A better interpretation was obtained from experts using fuzzy variables which defined various ranges to represent the framework outputs. These fuzzy variable representations were then used to provide a meaningful measure for any combination of the rules (see Appendix 10).

Table 5.16: Summary values of the five frameworks

Framework	Infrastructure Categories																													
	E	H	W/S	T	S/S	A	SS/R	E	H	W/S	T	S/S	A	SS/R	E	H	W/S	T	S/S	A	SS/R	E	H	W/S	T	S/S	A	SS/R		
FW1	M1							M2							M3							M4								
	0.6	0.6	0.5	0.7	0.2	0.3	0.7	0.6	0.6	0.5	0.7	0.3	0.4	0.7	0.4	0.6	0.4	0.6	0.3	0.3	0.7	0.5	0.5	0.3	0.6	0.2	0.2	0.5		
	M5							M6							M7															
	0.6	0.7	0.4	0.7	0.3	0.4	0.7	0.7	0.7	0.4	0.7	0.3	0.4	0.6	0.7	0.6	0.4	0.7	0.4	0.4	0.7									
FW2	M1							M2							M3							M4								
	4.6	4.3	3.3	3.7	3.8	4.4	6.0	3.4	3.6	3.8	4.3	3.8	4.1	5.8	2.6	2.8	2.6	3.8	3.5	4.0	4.5	3.5	3.8	3.4	4.1	4.2	4.3	6.0		
	M5							M6							M7															
	3.9	4.1	3.1	3.5	4.1	4.4	6.0	3.4	4.0	3.1	4.3	3.8	3.8	5.8	3.1	3.6	3.8	4.3	3.8	4.1	5.8									
FW3	M1							M2							M3							M4								
	4.7	4.5	5.3	4.0	3.6	3.8	3.7	5.0	3.3	4.5	5.0	4.1	5.3	6.1	3.9	4.0	3.2	4.0	3.4	5.5	4.1	5.1	4.1	3.6	6.0	4.8	5.7	6.7		
	M5							M6							M7															
	5.1	4.7	4.5	5.0	5.5	4.1	6.1	2.7	3.1	2.7	6.0	3.4	3.7	5.4	5.5	4.3	5.5	5.0	4.8	6.1	5.5									
FW4	M1							M2							M3							M4								
	3.7	3.6	4.7	4.6	3.0	4.1	5.7	3.7	3.4	4.5	4.6	3.0	4.2	6.0	3.4	3.4	4.5	4.6	3.4	3.8	5.6	3.4	3.6	4.9	4.3	3.8	4.3	5.9		
	M5							M6							M7															
	2.9	2.9	4.2	4.6	2.9	4.0	5.8	3.1	3.1	3.4	4.5	2.9	3.7	5.9	2.8	2.8	3.4	4.6	2.8	4.0	6.2									
FW5	M1							M2							M3							M4								
	3.7	3.5	4.5	4.9	2.8	3.2	5.4	3.4	3.2	4.4	4.7	2.6	3.7	6.0	3.2	3.2	4.5	4.7	3.2	3.5	5.4	3.4	3.7	4.9	5.4	3.3	3.9	5.7		
	M5							M6							M7															
	3.1	2.9	4.2	4.5	2.7	4.0	6.2	3.1	3.1	3.2	4.3	2.9	3.7	5.9	3.1	2.7	3.5	4.7	2.7	4.0	5.7									

The output of the integrated model is illustrated in Table 5.17. These data provide a measure of the impact generated on the quality of life of citizens from reconstructed infrastructure facilities in each category and each municipality.

Table 5.17: Defuzzified values from integrated fuzzy rules

	Φ						
Municipalities	E	H	W/S	S/S	A	T	SS/R
M1	51.62	51.62	50.19	51.62	51.51	51.11	48.40
M2	41.17	40.94	41.28	41.76	40.52	41.05	48.11
M3	41.65	45.26	43.92	44.31	41.99	40.69	42.59
M4	48.84	46.44	40.99	45.43	47.74	43.40	49.40
M5	40.69	40.02	40.58	40.57	41.06	40.96	47.48
M6	39.00	40.71	39.46	44.38	41.25	41.64	46.71
M7	40.69	39.19	40.70	40.52	39.94	44.74	49.10

The Φ values were used in an optimization model to carry out an equitable allocation of any available budget for reconstruction of infrastructure facilities amongst the competing municipalities.

5.3 PHASE 3

The Budget and Allocation of Infrastructure Facilities for Reconstruction. In adopting the research methodology, it should be noted that affected infrastructure facilities in any of the seven categories within the devastated municipalities may be selected for reconstruction within the district under investigation. The variable, $X_{i,j}$, was determined for each infrastructure facility, i, in a municipality. X represented the number of facilities in the infrastructure category, i, in municipality j. For this case study,

$$i = 1,2,.....7 \quad \& \quad j = E, H, W/S, S/S, A, T, SS/R.$$

Where E = Educational institution; H = Health; W/S = Water and Sanitation; S/S = Security and Safety (police posts); A = Administrative institutions; T = Transportation (Kilometers of roadway); SS/R = Social structures and recreation. (all X variables are integers).

This variable $X_{i,j}$ was either equal to the prewar number of facilities in the respective municipalities or a lower integer up to zero (i.e., a constraint, Equation 5.11).

The objective was to conduct a compressive replacement strategy of the infrastructure either destroyed or deteriorated as a result of the war and its associated consequences.

Objective function. This function was created in order to optimize the number of facilities allocated to municipalities based on the impact, Θ, generated in improving the quality of life of the beneficiary citizens. The value of Θ was obtained from the integrated framework output (see values in Table 5.17). It utilized fuzzy-based rules with respect to the opinions of experts in the field using the Mamdani implication operator. These values are indicated by the variable coefficients of $X_{i,j}$. The use of this function leads to the following formulation:

Maximize

$$51.56X_{1,E} + 40.65X_{2,E} + 37.36X_{3,E} + 41.37X_{4,E} + 41.07X_{5,E} + 45.30X_{6,E} + 41.46X_{7,E}$$
$$+ 50.97X_{1,H} + 44.91X_{2,H} + 39.41X_{3,H} + 41.50X_{4,H} + 40.77X_{5,H} + 43.62X_{6,H} +$$
$$+ 39.73X_{7,H}$$
$$+ 49.10X_{1,W/S} + 51.62X_{2,W/S} + 37.40X_{3,W/S} + 41.35X_{4,W/S} + 41.62X_{5,W/S} + 39.48X_{6,W/S}$$
$$+ 41.02X_{7,W/S}$$
$$+ 51.62X_{1,S/S} + 40.58X_{2,S/S} + 41.48X_{3,S/S} + 45.20X_{4,S/S} + 41.28X_{5,S/S} + 44.46X_{6,S/S}$$
$$+ 40.86X_{7,S/S}$$
$$+ 51.51X_{1,A} + 42.68X_{2,A} + 46.04X_{3,A} + 41.69X_{4,A} + 41.27X_{5,A} + 41.03X_{6,A} + 39.99X_{7,A}$$
$$+ 51.62X_{1,T} + 41.94X_{2,T} + 44.29X_{3,T} + 41.03X_{4,T} + 40.75X_{5,T} + 41.71X_{6,T} + 44.76X_{7,T}$$
$$+ 48.09X_{1,SS/R} + 47.96X_{2,SS/R} + 44.95X_{3,SS/R} + 47.49X_{4,SS/R} + 47.87X_{5,SS/R}$$
$$+ 46.85X_{6,SS/R} + 49.21X_{SS/R}. \quad \text{.....(5.1)}$$

subject to three points, described below.

1. A funding limit by infrastructure category: This entailed a restriction imposed on the maximum expenditure for infrastructure categories (see last column, Table 5.18). It indicates that the costs of reconstruction in municipalities (Table 5.1) should not exceed the imposed category funding limitation. The columns under M1 through M7 represent the cost in reconstruction a facility in an infrastructure category in the municipalities. These values were obtained from field survey.

The first constraint states that the total amount of funds spent in the education infrastructure category must be equal to or less than $900 000. This amount was pre-stipulated by senior management personnel, and similar situations applied to other

Table 5.18: Cost of Reconstruction/Rehabilitation (in $000)

Infrastructure Categories	Municipalities							Funding limit per category
	M1	M2	M3	M4	M5	M6	M7	
Education	45	44	43	45	47	48	45	900
Health	68	58	62	58	69	58	59	950
Water & Sanitation	12.5	13.5	12.5	12.5	18.5	12.5	17.5	275
Security & Safety	75	73	72	75	79	77	75	500
Administration	68	60	61	66	60	70	60	450
Transportation	100	90	95	98	90	95	93	1200
Social Services & Recreation	72	61	66	66	69	60	64	200

Hence,

$$(1)\ E:\ 45X_{1,E}+44X_{2,E}+43X_{3,E}+45X_{4,E}+47X_{5,E}+48X_{6,E}+45X_{7,E}\le 900_{E}\ldots\ldots(6.2)$$

$$(2)H:\ 68X_{1,H}+58X_{2,H}+62X_{3,H}+58X_{4,H}+69X_{5,H}+58X_{6,H}+59X_{7,H}\le 950_{H}\ldots\ldots(6.3)$$

$$(3)w/s:12.5X_{1,W/S}+13.5X_{2,W/S}+12.5X_{3,W/S}+12.5X_{4,W/S}+18.5X_{5,W/S}+12.5X_{6,W/S}$$
$$+17.5X_{7,W/S}\le 275_{W/S}\ldots(5.4)$$

$$(4)S/S:75X_{1,S/S}+73X_{2,S/S}+72X_{3,S/S}+75X_{4,S/S}+79X_{5,S/S}+77X_{6,S/S}$$
$$+75X_{7,S/S}\le 500_{S/S}\ldots\ldots(6.5)$$

$$(5)A:\ 68X_{1,A}+60X_{2,A}+61X_{3,A}+66X_{4,A}+60X_{5,A}+70X_{6,A}+60X_{7,A}\le 450_{A}\ldots\ldots\ldots(5.6)$$

$$(6)T:\ 100X_{1,T}+90X_{2,T}+95X_{3,T}+98X_{4,T}+90X_{5,T}+95X_{6,T}+93X_{7,T}\le 1200\ldots\ldots\ldots(5.7)$$

$$(7)SS/R:72X_{1,SS/R}+61X_{2,SS/R}+66X_{3,SS/R}+66X_{4,SS/R}+69X_{5,SS/R}+60X_{6,SS/R}$$
$$+64X_{7,SS/R}\le 200_{SS/R}\ldots\ldots(6.8)$$

categories. The reader should note that the constraint coefficient defines the cost of reconstruction of facilities (per $000), as indicated in Table 5.18.

2. Interdependency constraints: Any investments in health or education imply investment in water and sanitation. The interrelation of the variables had to be captured by the set of constraints:

Education

$$X_{1,E}+X_{2,E}+X_{3,E}+X_{4,E}+X_{5,E}+X_{6,E}+X_{7,E}-X_{1,W/S}-X_{2,W/S}-X_{3,W/S}-X_{4,W/S}$$
$$-X_{5,W/S}-X_{6,W/S}-X_{7,W/S}\le 0\ldots\ldots\ldots(5.9)$$

Health

$$X_{1,H} + X_{2,H} + X_{3,H} + X_{4,H} + X_{5,H} + X_{6,H} + X_{7,H} - X_{1,W/S} - X_{2,W/S} - X_{3,W/S} - X_{4,W/S} - X_{5,W/S} - X_{6,W/S} - X_{7,W/S} \leq 0 \quad \text{.....(5.10)}$$

3. Number of facilities constraint. Because of limitations in terms of available funds, restrictions are imposed on the number of facilities reconstructed in each municipality. Facilities should not exceed the total number available prior to the conflict (see Table 5.19).

Table 5.19: Postwar Number of Infrastructure Facilities

Infrastructure Categories	Municipalities						
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**
Education	4	2	3	3	3	2	3
Health	1	2	1	2	1	1	1
Water and sanitation	6	5	6	7	6	5	4
Security and Safety	1	1	1	1	1	1	1
Administration	1	1	1	1	1	1	1
Transportation	4	6	4	3	5	4	7
Social Services and Recreation	1	1	1	1	1	1	1

Hence,

E	H	W/S	S/S	A	T	SS/R
$X_{1,E} \leq 4$	$X_{1,H} \leq 1$	$X_{1,W/S} \leq 6$	$X_{1,S/S} \leq 1$	$X_{1,A} \leq 1$	$X_{1,T} \leq 4$	$X_{1,SS/R} \leq 1$
$X_{2,E} \leq 2$	$X_{2,H} \leq 2$	$X_{2,W/S} \leq 5$	$X_{2,S/S} \leq 1$	$X_{2,A} \leq 1$	$X_{2,T} \leq 6$	$X_{2,SS/R} \leq 1$
$X_{3,E} \leq 3$	$X_{3,H} \leq 1$	$X_{3,W/S} \leq 6$	$X_{3,S/S} \leq 1$	$X_{3,A} \leq 1$	$X_{3,T} \leq 4$	$X_{3,SS/R} \leq 1$
$X_{4,E} \leq 3$	$X_{4,H} \leq 2$	$X_{4,W/S} \leq 7$	$X_{4,S/SE} \leq 1$	$X_{4,A} \leq 1$	$X_{4,T} \leq 3$	$X_{4,SS/R} \leq 1$
$X_{5,E} \leq 3$	$X_{5,H} \leq 1$	$X_{5,W/S} \leq 6$	$X_{5,S/S} \leq 1$	$X_{5,A} \leq 1$	$X_{5,A} \leq 5$	$X_{5,SS/R} \leq 1$
$X_{6,E} \leq 2$	$X_{6,H} \leq 1$	$X_{6,W/S} \leq 5$	$X_{6,S/S} \leq 1$	$X_{6,A} \leq 1$	$X_{6,T} \leq 4$	$X_{6,SS/R} \leq 1$
$X_{7,E} \leq 3$	$X_{7,H} \leq 1$	$X_{7,W/S} \leq 4$	$X_{7,S/S} \leq 1$	$X_{7,A} \leq 1$	$X_{7,T} \leq 7$	$X_{7,SS/R} \leq 1$

..... (5.11)

All these data were entered into a LINGO program, which generated the number of infrastructure facilities for reconstruction in municipalities. The optimized results are illustrated in Table 5:20.

Table 5.20: Optimal solution to the LINGO linear integer programming model

	Facility Category						
Municipality	**E**	**H**	**W/S**	**S/S**	**A**	**T**	**SS/R**
M1	3	0	6	0	0	0	1
M2	2	0	5	0	0	0	1
M3	3	0	6	0	0	0	1
M4	3	1	7	1	1	0	1
M5	3	1	6	0	1	0	1
M6	2	1	5	1	1	4	1
M7	1	0	4	0	0	0	1
Total	**17**	**3**	**39**	**2**	**3**	**4**	**7**

As can be seen, a solution for municipality M1 is:

$X_{1,E}=3;\ X_{1,H}=0; X_{1,W/S}=6; X_{1,S/S}=0; X_{1,A}=0; X_{1,T}=0; X_{1,SS/R}=1.$

Both the education and sanitation/water areas showed prominence in all municipalities, as these categories are always critical for human and community well-being. Reconstruction or rehabilitation of social and recreational services also evidenced a considerable need across the seven municipalities. These deficiencies underscored the relevance of reinstating social activities as soon as possible in devastated municipalities.

The results of the model shown in Table 5.20 were then used to compute the impact generated in any combination of infrastructure facilities needed for reconstruction in municipalities and/or under any budgetary category. These values were computed by simply substituting the values of variables, $X_{i,j}$. The impact value associated with the optimum value for M1 was 502.17--i.e.,[(51.56×3)+(49.90×6)+(48.09×1)]. Similarly, the cumulative value associated with investment in the education category was 727.17. These values provide an indicative measure of improvement generated by reconstructed facilities, which in turn provides an indicator of improvement of quality of life in the beneficiary municipalities. These indicators are vital to donors as well as to the affected citizens, and especially to the governments of developed countries, (which provide the majority of funds for postwar reconstruction). Moreover, fuzzy-based techniques present great potential as a tool to be used in postwar infrastructure reconstruction.

In summary, Phase 1 framework provides a measure of five key factors influencing postwar reconstruction initiatives (capacity to sustain built facilities, donor

procedure and practices, current infrastructure state, government and national priorities, and coordination effectiveness). The integration of the frameworks, presented in Phase 2, provides a way to put together the five factors influencing postwar reconstruction. The aim for the integration was to achieve a holistic measure that provided a core input (Phase 3) to the linear optimization model to allocate most needed and limited resources (funds). In Phase 3, a detailed approach to the allocation of resources was presented. Because municipalities compete for possible best share of available funds, this phase helped achieve this process in the most equitable manner.

CHAPTER SIX

6. IMPACT MODEL VALIDATION

6.1 INTRODUCTION

This chapter discusses how the infrastructure reconstruction model is being tested in a postwar scenario similar to that of Sierra Leone. It presents the findings of data collection in Lofa County, Liberia, (which neighbors Sierra Leone to the southeast). Liberia was selected for validation since it shares similar characteristics to postwar Sierra Leone. Although this district borders Sierra Leone and may share commonalities, the Kambia District of Sierra Leone itself does not share a common border with Lofa County. Furthermore, the demographics of these two locations differ. (A demographic profile of the county is outlined and a determination of the framework variables or criteria, if any, which have a significant effect on the selection of infrastructure projects for reconstruction is also discussed in Appendix 5.).

The purpose of this validation exercise has been to assess the model as a tool in implementing a postwar reconstruction strategy that is responsive to other countries facing similar challenges to those facing Sierra Leone. The validation process has identified commonalities and variations, as well as lessons learned and best practices that will benefit future programming.

The civil crisis has severely impacted the citizens of the county, leaving a trail of destroyed public and private infrastructure, and provoking a massive exodus of people to other locations (within the country or in neighboring countries). The crisis has also resulted in significant damage to social and economic institutions. The Liberian civil war officially ended in 2004 and people are returning to the county ready to exploit the opportunities of the land. The citizenry yearn for an enduring and stable environment that is conducive to restoring development in the municipalities.

The sections that follow discuss the current state of infrastructure categories in the county and how this research work can provide the support needed in Liberia's postwar reconstruction.

Donor Funding. International humanitarian funding has been pivotal in ensuring that basic, life-saving social services have been provided to the citizens of Lofa County. It is estimated that close to 80% of infrastructure services are provided by NGOSs funded

by the donor community. The funds are grossly inadequate, and unless they come to be committed adequately and reasonably, lack of access to basic services such as health care, safe water and sanitation, education, and security will present an additional burden to vulnerable populations, particularly in the under-served municipalities in the county.

6.2 INFRASTRUCTURE SITUATION

The gap across infrastructure facilities is a critical issue in postwar situations. A series of factors contribute to the issue:

1.insufficient facilities and their associated poor conditions;

2.lack of skilled and experienced staff;

3.lack of capacity to effectively manage infrastructure facilities;

4.lack of resources;

5.issues related to how the reconstruction process is addressed; and

6.issues pertaining to centralized planning and management of infrastructure categories—difficulty to progressively expand responsibilities.

Overwhelmingly, the majority of functional infrastructure facilities in the county are supported by NGOs. As such, losing NGO support is significant as it leads to:

- disruption of service delivery;
- higher out-of-pocket cost for a given service;
- vastly reduced access;
- decreased utilization of service;
- closure of facilities; and
- increased instability.

According to the United Nations-World Bank joint assessment needs report (2004, p.10), challenges remain in terms of the achievement of three major goals. The first is to lay the foundations for the sustainable rebuilding of Liberia's infrastructure, both to support community-based, development-driven reconstruction and to create the environment necessary for private-sector investment. The second goal is to increase the confidence of private investors and the donor community as to the stewardship of public finances by relevant government agencies, specifically by ensuring adequate transparency and accountability of financial and budgetary management. The third goal is to establish

a mechanism through which nations and institutions can be partners in the transition process, the reviewing process against a results-focused transition framework, as well as in managing and coordinating contributions.

In summary, the destruction of infrastructure, lack of funds, deterioration of support systems, and attrition of the public workforce all call for an identification of priorities through needs assessment processes in order to aid equitable and transparent reconstruction strategies. To complement these processes, it is essential to restore the capacity to deliver services and to put reconstructed facilities and services in a position to guarantee the continuation of service delivery (United Nations / World Bank, 2004).

A rapid assessment validation and strategy design workshop report (August 2-4, 2006, p.27) for Liberia postwar reconstruction has identified four priority issues deemed to be important for demonstrating the Government of Liberia's position on infrastructure reconstruction. The first issue is concerned with the need to develop a matrix for current and potential sources of funding. The second issue has to do with the need for clear policy direction, action, commitment, transparency, and accountability from the government. The third issue is the need to find alternative mechanisms to fund infrastructure category systems and ensure access to quality service and care for the population, with an emphasis on the most vulnerable groups. Finally, the fourth issue deals with financial efficiency in the delivery of quality infrastructure services. This would, therefore, require a rehabilitation program covering the inputs of the five frameworks which underpin this research: sustainability capacity, donor procedures and practices, current infrastructure state, government and national priorities, and coordination effectiveness.

Questionnaires. The research validation assessment was conducted by visiting relevant ministries, supporting NGO institutions, and donor representatives in Monrovia and Lofa County. The data collected was cross-checked through community and household interviews in municipalities within the county. The community questionnaire is composed of the following indicators: demographic information, economic, scale of infrastructure destruction, agriculture, education, health, markets, community organizations, and community priorities. Additional details about the number of infrastructure facilities before and after the war; how many are still functional; and for

those not functional, the reasons for not functioning; were posed. The availability of personnel (both qualified and unqualified) in each functional facility and the number required according to the establishment were also investigated. Although the approach is somewhat subjective, it provided knowledge on the distribution pattern of infrastructure facilities (in each of the categories) and the status (including auxiliary support systems, financing, and stakeholders) across the county.

The following sections provide an analysis of some of the issues associated with the research model framework criteria previously discussed in terms of how they are reflected in the county. The associated variations in the framework parameters for the new Lofa validation scenario are also discussed, and explanations as to how the methodology is adjusted to incorporate these variations are noted.

Health Infrastructure: A summary of the current condition of health facilities in Lofa County is illustrated in Table 6.2. Additional information about the ownership of infrastructure facilities for those that are functional is given in Table 6.2, last column. The current estimates of health infrastructure facilities (both functional and non-functional) are estimated at 78. Of these facilities, 23 were destroyed, 43 suffered major damage, and 12 had minor destruction. Accordingly, the process of upgrading these facilities in partnership with NGOs and donor agencies has begun.

The outstanding obstacles to a compressive reconstruction initiative according to the rapid assessment validation and strategy design workshop report (2006, p. 17) involve the following:

- lack of resources and limited knowledge of overall budget to support the reconstruction process;
- debilitated and substandard structures which are uneven and not user-friendly;
- health worker shortage and poor distribution as a result of cessation of government-sponsored rural service;
- lack of stakeholder information, coordination, and standards;
- reliance on international NGOs decreased the activity of local NGOs, and NGO registration not clearly defined; and
- unclear national budget construction framework.

From field survey results and existing records up to 1990, Lofa County had 53 health centers, 43 clinics, and 4 hospitals serving the six districts (HCS-Lofa, 2005). However, all of these health institutions suffered different levels of destruction during the wars. Table 7.2 illustrates these variations in destruction level. It is notable that mobile clinics can only be accessed twice a week in areas where no health facility exists. People are therefore required to walk long distances to reach the nearest health facility on those days when mobile services are not available. More broadly, the county still lacks a functional hospital.

Education. Liberia's education system has been among the weakest in Sub-Saharan Africa for the past two decades due to lack of adequate resources, poor infrastructure, and limited expenditure in the national budget (United Nations / World Bank, 2004, p. 53). While there is limited reliable data for recent years, the research survey has indicated that violence, widespread destruction of infrastructure, displacement of large sections of the population, and the continued degradation of the educational institutions have had a devastating impact on virtually all components of the education category.

According to the field data and community responses combined with statistics from UNMIL and the County Education Office, 188 schools (12 of them secondary), including public schools, mission schools, and private schools, existed in Lofa County prior to the massive destruction. However, fighting destroyed the majority of them. Estimates from the Ministries of Education and Planning and Economic Affairs indicated that more than half of the schools (predominantly primary schools) which did survive the destruction are not environmentally safe for students. Table 6.3 illustrates the current situation of education infrastructure in the county. The utilization of current functional schools is poor at all levels. The reasons for which boys and girls of primary school age were not enrolled or fully attending school in Lofa County are typical to the Sierra Leone scenario. The main reasons for school age children not attending school included lack of school fees, other work requirements at home, no food, and no school in the area of residence. The deplorable condition of the educational system in the county has also been attributed to the especially long period of disruption caused by the war. This manifested itself in a situation wherein 65% of boys and 62% of girls became over-age for primary

Table 6.2: Health Infrastructure facilities situation in Lofa County

Lofa County District	Number before war			Current status									# operated from private residence
	Hospital	Health Center	Health Clinic	Hospital			Health Center			Health Clinic			
				Minor	Major	Destroyed	Minor	Major	Destroyed	Minor	Major	Destroyed	
Kolahun	1	6	4	-	1	-	1	3	2	1	1	2	1
Voinjama	2	23	15	-	1	1	2	13	8	2	3	10	4
Foya	1	7	10	-	-	-	-	2	5	1	7	2	2
Zorzor	0	12	3	-	-	1	-	3	9	1	1	1	2
Salayea	0	2	6	-	-	-	1	1	-	1	3	2	1
Vahun	0	3	5	-	-	-	-	1	2	1	2	2	1
Total	4	53	43		2	2	4	23	26	7	21	15	11
Current Functional	2	13	30										

Table 6.3: Education Infrastructure facilities situation in Lofa County

Lofa County District	Number before war			Current status								
	Primary	Secondary	Adult Literacy	Primary (including Pre-primary schools)			Secondary Schools			Adult Literacy Schools		
				Minor	Major	Destroyed	Minor	Major	Destroyed	Minor	Major	Destroyed
Kolahun	56	7	9	11	5	30	3	1	5	4	2	3
Voinjama	36	7	14	22	5	9	6	1	0	11	1	2
Foya	39	4	7	3	13	26	1	2	1	1	4	2
Zorzor	32	7	15	16	3	13	5	1	1	11	2	2
Salayea	15	7	9	11	2	2	3	1	3	6	2	1
Vahun	10	1	1	0	1	9	0	0	1	0	0	1
Total	188	33	55	63	29	89	18	6	11	33	11	11
Current Functional	52	17	29									

schooling (United Nations / World Bank, 2004, p. 53). This trend, according to the same report, is repeated for secondary school, where almost 45% of boys and 27% of girls are between 20-25 years old; an age by which students in other societies have finished a university study program.

Water and Sanitation. Currently the population has access to water, though the majority of wells have dirty water or other obvious contamination. Of the 100 wells randomly inspected during data collection, 40 were in use. 80% of the functional wells require dewatering, cleaning, and chlorination. Household interviews provided important findings about general access to drinking water. Boreholes with pump, unprotected well, stream and ponds are the main sources of drinking water. In Salayea municipality, a high percentage of the sampled households reported that they obtained drinking water from a borehole equipped with a pump. Likewise, households in Kolahun and Voinjama municipalities reported fetching water from boreholes with pumps. The proportion of households drawing drinking water from pumps is lower in Foya and Zorzor Districts, though, according to a senior officer of Action Aid (International NGO). Access and use of toilet facilities is also limited in the county. Use of latrines is not mentioned at all in Salayea and Zorzor Districts, and any latrines mentioned are primarily the improved type (VIP latrines) constructed by NGOs.

Security and safety. The 14 years of civil war, the disruption of judicial infrastructure, loss of traditional law enforcement structures, challenges associated with ensuring the rule of law, and the return of people in high numbers to municipalities from which they had fled have all contributed to creating an environment where there are frequent cases of crime. The formal justice system remains unable to deal with more than a handful of crime-related incidents. Security forces, such as police and military personnel, are ill-equipped and their presence is not felt in every municipality. The majority of judicial cases are either not addressed or are "compromised" in municipalities or villages for a few dollars. Ensuring the return and reintegration of Liberian refugees under conditions of safety and dignity has also been a key issue.

Road Network. The road network is in deplorable condition. Since the county was officially declared safe in early 2005, only one road-related infrastructure project has gained approval. It involves rehabilitating two box-culvert bridges linking Zorzor and

Table 6.3: Education Infrastructure facilities situation in Lofa County

Lofa County District	Number before war			Current status								
	Primary	Secondary	Adult Literacy	Primary (including Pre-primary schools)			Secondary Schools			Adult Literacy Schools		
				Minor	Major	Destroyed	Minor	Major	Destroyed	Minor	Major	Destroyed
Kolahun	56	7	9	11	5	30	3	1	5	4	2	3
Voinjama	36	7	14	22	5	9	6	1	0	11	1	2
Foya	39	4	7	3	13	26	1	2	1	1	4	2
Zorzor	32	7	15	16	3	13	5	1	1	11	2	2
Salayea	15	7	9	11	2	2	3	1	3	6	2	1
Vahun	10	1	1	0	1	9	0	0	1	0	0	1
Total	188	33	55	63	29	89	18	6	11	33	11	11
Current Functional	52	17	29									

Salayea municipalities. More then 10 000 farmers are expected to benefit from this bridge rehabilitation as it connects the major towns and villages in the two municipalities. In general, poor roads and bridges have hampered project monitoring across the entire project community. The rehabilitation of infrastructure (including roads) is a vital cross-cutting feature of the three strategic priorities. Poor access to communities severely limits the effectiveness of assistance and limits the positive impact humanitarian action would otherwise have on vulnerable and under-served communities.

6.3 COMMUNITY PERCEPTION OF NEEDS

In the priority listings for the municipalities, focus group findings have revealed needs tend to be similar across the municipalities, although there are variations in the importance given to the type of priority. Five immediate community priorities for development projects were noted and are presented below.

- **Construction of shelters**. Fighting in the county left many towns and villages completely wiped in terms of residential structures, in addition to other destruction of property. Houses destroyed through years of fighting must be rebuilt. The municipal representative pointed out that the shortage of housing is hindering the resettlement of refugees and IDPs in their original areas of residence. Respondents noted that some families would not opt to return unless guaranteed sufficient support to construct residential houses. The net effect could be an increase in split families with only a portion of family members choosing to come.

- **Construction of Health facilities/provision of health services.** The argument raised reiterates that virtually all health facilities were destroyed during the wars. In some districts, (e.g., Salayea), no health facility had been reconstructed at the time of data collection. Thus, basic health service provision is impeded. The municipalities are calling for a revitalization of these facilities and a strengthening of basic health service provisions. In addition, human resources and logistics have been identified as important health amenities requiring revitalization

• **Rehabilitation of educational facilities, including skills training.** A number of NGOs have suggested that schools suffered a rather even and severe level of destruction across the municipalities, and thus children (especially in less accessed municipalities like Salayea) are still excluded from the learning process by the sheer absence of schools. In addition, many youth have missed the chance to acquire a formal education, some having already advanced to adulthood. The rebuilding of skill development institutions was given a high priority rating so as to guarantee some engagement for these adults who had missed the opportunity for formal education. Respondents saw this as a means of reducing the vices that accompanied idleness, especially among ex-combatants.

• **Water and sanitation**. An improvement in the quality of drinking water is felt to be of particular importance in most municipalities. In addition to water and sanitation, revitalization of agricultural production was also prioritized. Residents in virtually all municipalities in the county depend primarily on farming and gardening for their survival. Currently, the already resettled farming population is involved in the cultivation of cash crops of rice and vegetables despite the fact that they are farmers are not properly equipped. Inadequate financing of meaningful production and materials and crude agricultural skills are major constraints to rehabilitation and proper maintenance of crops such as cocoa, coffee, palm, and other cash crops.

• **Local authority.** The restoration of local authority beginning with the establishment of basic functionality also surfaced as a priority area in the county's recovery and reconstruction efforts. The reestablishment of local authority is critical to maintaining order and the traditions of municipalities, thus enabling them to undertake pressing development and recovery challenges. At present, the governance capacity of local bodies throughout the county is very weak – in keeping with the centralization of power that has characterized the history of the country and been reinforced by the destruction of infrastructure during the years of war. The restoration of authority and capacity in Lofa County requires training, physical rehabilitation, equipping of offices, and a mechanism to ensure coordination with central government authorities.

In conclusion, it is of note that not much was discussed or stressed about security or administration (i.e., municipal ruling structures). People are much more concerned

with their immediate, daily, basic needs. Conversely, donors want to see proper re-establishment of security functionaries, including traditional rulers in all municipalities *before* they commit their funds. Interestingly, few participants discussed the judicial system, which is in shambles, or the crisis of women and children suffering from gender-based violence (GBV). Those interviewed conclude that in order to address the problem of GBV in Lofa and Liberia as a whole, reformation of the justice system must be prioritized, especially as it relates to crimes of GBV that continue to subject women and girls to injustices which promote their subordination and impede their development.

6.4 ADAPTABILITY OF METHODOLOGY

The postwar characteristics of Lofa County, Liberia are very similar to those of Kambia District, Sierra Leone. Both of these countries have suffered high scale destruction in all categories of infrastructure. They also have political and social similarities: having been devastated, in both cases, as a result of weak and corrupt governance. The human characteristics were similar, and the decline in the quality of life of citizens was alarming in both regions (Lofa and Kambia). In a bid to help alleviate the sufferings of the people, both countries are benefiting substantially from the donor community in rebuilding destroyed infrastructure. Both are receiving tremendous amounts of input assistance from international and local NGOs.

Both countries / municipalities are highly endowed with natural resources, but remain poor due to a lack of proper management of these resources. Technical capacity and the capacity to sustain reconstructed facilities do not differ greatly between Lofa County and Kambia District. The coordination effectiveness among stakeholders in the reconstruction process has not been clear or well understood. Inconsistencies in the perceptions of citizens in terms of embracing projects seem to be related to the immediate needs of the municipalities, and this dynamic has followed a similar trend in the two localities. The donor conditionality and preferences, though, varied depending on donor agency. These donor characteristics are internal attributes of the donor institution and rarely change in countries of operation.

There are, however, a few pronounced differences between the two districts. Lofa County was quite recently declared a safe county (November, 2005). Many of the refugees and internally displaced are yet to return to the municipalities they fled during the war. In public or government buildings that housed refugees, there are reported problems of reluctance of people to vacate such buildings, even when there is approved funding to rehabilitate the facility. The institutions (police, tribal chiefs, government representatives) that would influence the return of citizens are not properly established. One other key difference is in the area of ownership of infrastructure facilities. Many of the public service infrastructure facilities are owned by private citizens in Lofa County. The government either pays rent for the utilization of these structures or uses them for free.

Kambia District is comparatively more settled and awaits intervention from the government and donor communities. It is uncommon for the GOSL to use private buildings on a permanent basis to serve the public. Such buildings are only used temporarily, until a government-owned facility is available. Also, Kambia District does house the displaced in public buildings, and there are transit centers provided for those in dire need of shelter.

6.5 INCORPORATING COUNTRY SITUATION DIFFERENCES IN MODEL

The model frameworks proposed and used in this research are adapted to address different postwar situations. The sustainability framework (FW1) addresses the different cultures, economic conditions, and perceptions of citizens in each of the municipalities in the county regarding an infrastructure category. The criteria used for the evaluation of need (as presented in Table 1) can be reformulated to achieve the desired goal. The criteria illustrated in Table 1 were reassessed by the focus groups and found to be suitable for adoption to the Lofa County situation.

The framework (FW2) that defined the criteria and assessed donor procedures and practices did not vary considerably in Lofa County. There has been an ongoing debate that donors should provide added evaluation criteria to address situations where refugees refuse to vacate the premises of an organization that has or intends to provide funding.

Relocating refugees to a temporary transit center and redirecting funding to other areas were incorporated in this study's evaluation framework.

The current infrastructure state (FW3) was applicable for the assessment of infrastructure facilities, given its successful application in Lofa County. Government and national priorities (FW4) encountered refinements of the criteria descriptions. Although all previously defined criteria that defined the framework for Kambia District are applicable, focus group participants were anxious for the government to address the issue of shelter (i.e., housing) for the returnees.

Hence, analysis of government endeavors to provide permanent accommodation for those whose homes were destroyed became part of the model criteria, and possible modes of support were deliberated about. Issues such as provision of shelter support materials (cement, C.I. sheets, nails, etc.), construction, and distribution were integrated into the framework. The matter of collaboration of government representatives with the former rebel group of Charles Taylor was also discussed. This was removed from the model, though, as some members of the focus group saw it as politically sensitive. The coordination effectiveness framework (FW 5) evaluation criteria were similar in the two localities. All agreed to carryout assessments based on the Kambia District formulation.

In conclusion, the two localities (Lofa County and Kambia District) share considerable commonalities. The differences are easily adjusted by incorporating them into the appropriate frameworks as illustrated in Figure 6.1.

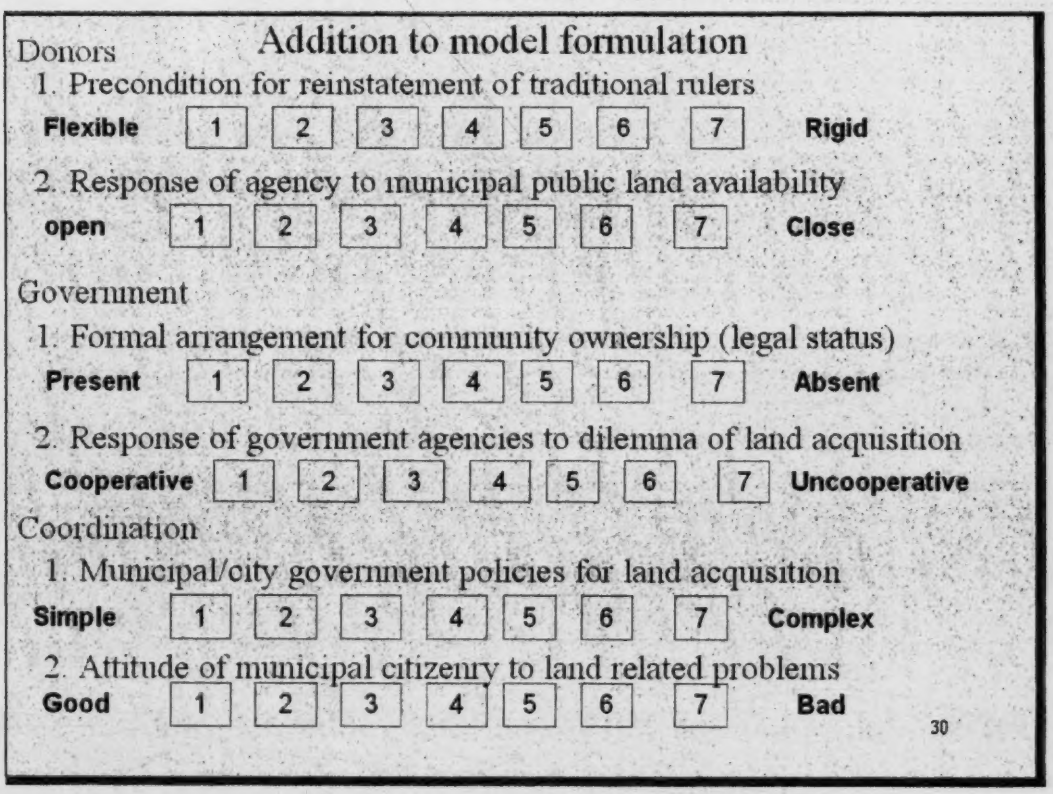
Addition to model formulation
Donors
1. Precondition for reinstatement of traditional rulers
Flexible 1 2 3 4 5 6 7 Rigid
2. Response of agency to municipal public land availability
open 1 2 3 4 5 6 7 Close
Government
1. Formal arrangement for community ownership (legal status)
Present 1 2 3 4 5 6 7 Absent
2. Response of government agencies to dilemma of land acquisition
Cooperative 1 2 3 4 5 6 7 Uncooperative
Coordination
1. Municipal/city government policies for land acquisition
Simple 1 2 3 4 5 6 7 Complex
2. Attitude of municipal citizenry to land related problems
Good 1 2 3 4 5 6 7 Bad
30

Figure 6.1: Adjustment to the model frameworks for Lofa County Scenario

Table 6.4: Summary values of the five frameworks for Lofa County, Liberia

FWs	Municipalities and Infrastructure Categories																								
	E	H	W/S	T	S/S	A	SS/R	E	H	W/S	T	S/S	A	SS/R	E	H	W/S	T	S/S	A	SS/R				
	M1							M2							M3										
FW1	0.5	0.6	0.4	0.6	0.3	0.4	0.5	0.5	0.7	0.6	0.5	0.4	0.5	0.6	0.3	0.7	0.3	0.7	0.5	0.4	0.6				
	M4							M5							M6										
	0.4	0.5	0.3	0.5	0.6	0.5	0.5	0.5	0.6	0.5	0.4	0.4	0.5	0.4	0.4	0.5	0.3	0.6	0.5	0.3	0.6				
	M1							M2							M3										
FW2	4.5	4.6	3.4	3.7	4.6	4.4	5.0	2.3	4.3	4.3	5.2	4.4	4.8	6.2	3.3	4.5	3.4	3.1	3.2	4.0	4.8				
	M4							M5							M6										
	4.2	3.7	3.6	3.8	3.4	5.3	4.7	5.3	4.6	3.7	4.6	4.8	4.7	5.4	4.1	4.6	5.5	4.3	3.4	3.1	6.4				
	M1							M2							M3										
FW3	3.2	5.7	4.3	3.4	4.3	5.6	4.5	4.2	4.4	3.6	4.8	5.3	4.8	5.7	3.9	4.0	3.2	4.0	3.4	5.5	4.1				
	M4							M5							M6										
	4.3	3.3	5.6	4.2	6.1	3.2	5.4	3.7	2.6	4.5	4.3	3.4	4.9	6.2	5.5	4.3	5.5	5.0	4.8	6.1	5.5				
	M1							M2							M3										
	3.7	3.6	4.7	4.6	3.0	4.1	5.7	3.7	3.4	4.5	4.6	3.0	4.2	6.0	3.4	3.4	4.5	4.6	3.4	3.8	5.6				
FW4	M4							M5							M6										
	2.9	3.9	3.2	5.4	2.5	4.8	3.8	3.1	3.7	3.4	4.6	2.9	3.9	5.9	2.8	2.5	3.4	4.6	2.8	4.0	6.2				
	M1							M2							M3										
FW5	4.7	4.8	4.9	4.7	3.8	5.2	4.3	4.3	3.2	4.4	4.7	2.6	3.7	6.0	3.2	3.2	4.5	4.7	3.2	3.5	5.4				
	M4							M5							M6										
	2.2	3.4	5.6	5.5	3.4	6.2	6.0	3.1	3.8	3.2	4.3	2.9	3.7	5.9	3.1	2.7	3.5	4.7	2.7	4.0	5.7				

Three frameworks were adjusted (i.e., Donor procedures and practices, government and national priorities, and coordination effectiveness) to reflect the observed differences between postwar reconstruction activities in Kambia District (Sierra Leone) and Lofa County (Liberia). The additions needed in the affected frameworks are illustrated in Figure 6.1. A summary of the results obtained through analysis of the five model frameworks is shown in Table 6.4.

The defuzzified values from the integrated framework are shown in Table 6.5. These values provide the coefficients for the linear optimization model.

Table 6.5: Defuzzified values from integrated fuzzy rules for Lofa County

	Φ						
Municipalities	E	H	W/S	S/S	A	T	SS/R
M1	61	62	56	63	63	64	62
M2	52	51	55	53	51	51	42
M3	51	56	52	57	54	52	43
M4	56	49	51	58	61	56	52
M5	48	51	52	51	53	51	53
M6	41	52	47	52	59	53	52
M7	51	47	51	52	48	53	61

The constraints of the linear optimization model used in the Kambia scenario were used for Lofa County. The limitations in the amount of funds allocated in each infrastructure category and the number of prewar infrastructure facilities was assumed to be the same. This was because Liberia has just begun the process of implementing development projects. Donor attention is currently shifting from emergency support (i.e. provision of food, temporary shelter, and reintegration exercise) to provision of public infrastructure facilities. Full scale reconstruction is at preliminary phase. The optimized values using Lingo program are illustrated in Table 6.6. As can be seen, a solution for municipality M1 is:

$$X_{1,E}=1;\ X_{1,H}=2;\ X_{1,W/S}=4;\ X_{1,S/S}=2;\ X_{1,A}=1;\ X_{1,T}=1;\ X_{1,SS/R}=0.$$

Water and sanitation area of infrastructure showed prominence and hence, high need in all municipalities, as this category is always critical for human and community well-being. Reconstruction or rehabilitation of health, security and safety, and education

also evidenced a considerable need across the six municipalities. These deficiencies underscored the relevance of reinstating the quantities resulting from the optimized linear model in devastated municipalities.

Table 6.6: Optimal solution to the LINGO linear integer programming model for Lofa County

	Facility Category						
Municipality	**E**	**H**	**W/S**	**S/S**	**A**	**T**	**SS/R**
M1	1	2	4	2	1	1	0
M2	1	3	6	1	1	1	0
M3	2	1	5	1	1	1	0
M4	2	2	8	3	1	1	0
M5	1	2	5	1	1	1	1
M6	1	0	3	2	1	1	0
Total	**8**	**10**	**31**	**10**	**7**	**7**	**1**

In conclusion, it became obvious that the model could be used in postwar countries to effectively, and in a transparent manner, allocates the limited funds available in order to reconstruct municipalities devastated by wars. The integration of inputs addressed the concerns of donors, governments, communities; the extent of devastation made the methodology credible and acceptable by stakeholders. The infrastructure reconstruction impact model shows great potential as evidenced by this research.

CHAPTER SEVEN

7. CONCLUSIONS, RECOMMENDATIONS, CONTRIBUTIONS

The purpose of this chapter is to summarize this study and offer conclusions and recommendations.

7.1 SUMMARY OF RESEARCH

The wars in Sierra Leone and neighboring Liberia affected all categories of the infrastructure at varying scales in municipalities. The consequences of this damage and deterioration of infrastructure are reflected in the deplorable quality of life situation of the citizenry and their communities. Adequate funding is major factor constraining the capacity of Sierra Leone and Liberia governments to replace the devastated infrastructure. The governments' resource revenue falls below the expenditure required to provide the most minimal level of infrastructure. Hence, funding for postwar reconstruction and specifically international aid is a crucial component of the process. The funds must be used effectively and efficiently in order to have a positive impact to improving the quality of life of the people.

Current decision-making processes and procedures for selecting, allocating, and distributing both government and donor funding is neither effective nor efficient. The process of rating infrastructure projects in war torn Sierra Leone was found to be complex; especially when appropriate data were almost nonexistent. It is therefore necessary to identify the multiple criteria of infrastructure investment projects with the conflicting objectives of the stakeholders and the current state of the infrastructure in respective municipalities in order to properly prioritize reconstruction.

This research involved the development of a model to aid:

1. the selection of competing municipalities and their infrastructure for reconstruction, and
2. the allocation and distribution of limited funds for infrastructure rebuilding.

The methodology used an impact-based evaluation that assessed sustainability capacity of municipalities (Framework 1), donor procedures and practices (Framework

2), current infrastructure status (Framework 3), government and national priorities (Framework 4), and coordination effectiveness (Framework 5). Analyzing each framework separately was found to be very effective. All key stakeholders' concerns about the capacity of a municipality to sustain built infrastructure, about municipality preferences, procedures and practices of donors, alignment of projects with national priorities, and the coordination issues were all represented and addressed in this study.

A rule-based technique using fuzzy rules was used to integrate the outputs of the frameworks to obtain a holistic representation of the measure of impact on quality of life generated through the reconstruction of an infrastructure facility. An integration of the five factors affecting postwar reconstruction initiatives, addressed in the form of frameworks, was considered to be an appropriate measure of need in municipalities. The outputs of the integrated model were used in a linear optimization (in a LINGO program) model to select municipalities and allocate funds for infrastructure reconstruction.

The donors used the values to compute a measure which reflected the impact generated from any reconstructed facility. However, the numerical values of the computed impact tend to change depending on whether it is the first or a subsequent instance of funding. For any of these funding instances, re-evaluation of the three phases of the methodology became necessary. In analyzing any funding situation, a new set of integrated output values was compiled which always resulted in a different set of values. Most importantly, it should be noted that the optimized results reflected decisions made solely with respect to the allocation of infrastructure facilities based on available funds (funding gap).

In summary, all three research objectives were met. The applied tools (AHP, Hamming Distance, and Semantic Difference techniques) were very effective in aiding analysis of the frameworks. The resulting values of the integration of framework values provided an optimal, transparent way of allocating limited funds with inputs from all stakeholders in the reconstruction process. The utilization of integrated values in a linear optimization model (with Lingo programming tool) facilitated an equitable allocation of funding for reconstruction to municipalities competing for these monies.

Thus, the major findings based on the data can be summarized as follows:

1. Education, Health, Water & Sanitation infrastructure showed prominent need in terms of numerical values;

2. The capacity for sustainability was not significantly different among the 7 municipalities;

3. Donor commitment and was generally "neutral" – neither strongly for or strongly opposed in prioritizing projects for postwar reconstruction; and

4. Destruction of municipalities was relatively uniform—all communities suffered extensively.

7.2 CONCLUSIONS

Based on the research findings, the following conclusions are derived.

1. The model proved effective in terms of identifying categories of reconstruction need.

2. The process of allocation using the impact model provided transparency because it involved all key stakeholders in decision-making (donors, governments, citizens).

3. The model provided a credible measure of addressing competing needs equitably, and with integrity.

4. The capacity of municipalities to sustain infrastructure reconstruction after donor funding is completed can be ascertained using this model.

5. The model limits or reduces bias, corruption, and influence on the decision-making processes.

7.3 CONTRIBUTION TO RESEARCH AND THEORY

Very few attempts have been made to link infrastructure funding with the various determinants at government, donor, and municipal levels. In general, the development of a methodology or tool which integrates postwar reconstruction stakeholders' influences in allocating infrastructure facilities has not gained much recognition in research.

This study focused on finding a tool for allocating infrastructure facilities to war devastated municipalities, thus facilitating the decision-making processes in a postwar setting. In attempting to solve the problems faced by stakeholders in postwar reconstruction, this research provides three key contributions to knowledge.

1. The model is effective and efficient for utilizing frameworks to analyze factors that affect postwar reconstruction

This analysis provides numerical values for each factor which can be used for assessment. This represents a unique contribution in being a first attempt to quantify effects of donor procedures and processes, government national priorities, coordination effectiveness, and infrastructure sustainability for postwar reconstruction.

2. The model integrates 3 distinct processes to provide an index that represents a measure of an infrastructure category.

The integration process of bringing the 3 processes together provides a detailed assessment of key factor in postwar reconstruction. The values from using fuzzy rules results in an effective measure / indicator of quality of life.

3. The numerical value from the integration process provides a way of estimating the improvement/impact resulting from reconstruction.

These impacts can provide a reliable measure of accountability and a strong baseline to be used for comparison.

7.4 RECOMMENDATIONS FOR FUTURE RESEARCH

Although this research represents a comprehensive study of a proposed reconstruction model, several issues require additional investigation.

1. A similar study using this model with multiple donors, simultaneously, would be beneficial.
2. A similar study with a larger number of municipalities, or an entire province, would provide greater representation and thus greater reliability of the model.

In summary, this reconstruction impact model yielded positive results of a limited postwar situation. The benefit to postwar countries and donor agencies will be determined by application and/or implementation. I anticipate this will transpire, with positive results for donors, citizens, communities, and governments.

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Appendix 1: Research Setting

Sierra Leone is located on the west coast of Africa, bordering the Republic of Guinea to the north and Liberia to the south, (Figure 1.1). It has an estimated population of about six million with various ethnic groups, cultures, and traditions represented therein. This small West African state was colonized by the British immediately following the abolition of the slave trade.

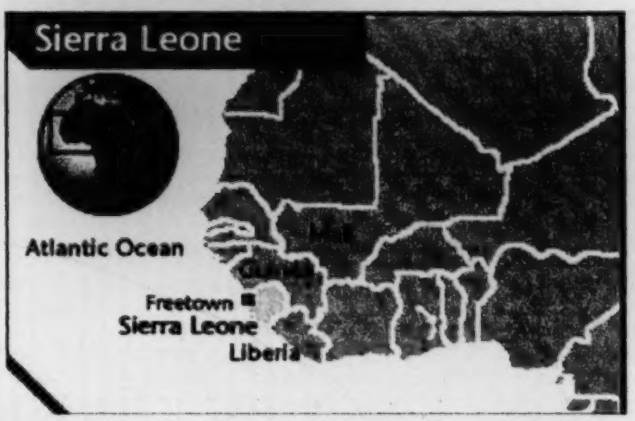


Figure A1-1: Map of West Africa highlighting Sierra Leone

Sierra Leone gained independence from Great Britain in 1961, embracing the democratic ideals inherited from their colonial fathers (Bundu and Kerefa-Smart, 2000 - 19). The principles and practices of separation of powers and the rule of law which are fundamental to the survival of democracy, were observed by the infant democracy. The people chose their leaders freely and fairly, as evidenced by the victory of the opposition party in the first post-independence elections in 1967.

Corruption and other forms of bad governance were hardly heard of in these early stages of independence. However, the situation worsened when, in 1968, the new government assumed office and initiated a rapid transformation of the country into a single party state. With the other political parties formally rendered dysfunctional and illegal, the new ruling party practically eliminated opposition to its policies and became an unchallengeable monolith.

Under the single party administration, traditional democratic institutions collapsed. In particular, the judiciary and parliament were demoted to mere rubber-stampers of the policies of the executive (Shade, 2006). The most significant local governments, the district councils that formed the nucleus of participatory democracy and community development initiatives, were completely abandoned. The once revered traditional institution of paramount chieftaincy was politicized, its dignity eroded. City or Town councils were reduced to mere management committees appointed by the government of the day. The majority of the appointees to these committees were either party thugs or stalwarts. The military, the police, and the civil service were all politicized as political patronage determined recruitment and promotions in these institutions. The

consequences of these were an inefficient and corrupt civil service, unproductive police force, and a distrusted military.

Thus the single party system over-centralized the government and deprived the citizens of their right to choose their leaders freely. Corruption was institutionalized, and maladministration of justice became so commonplace that the citizens lost confidence in the judiciary and the common law enforcement machinery, socio-economic facilities dwindled, social services degenerated, and infrastructural development moved at an appallingly slow pace.

At the same time, the rural agriculture sector which employed over 70% of the population was neglected. Rural production and income in turn dwindled and poverty increased dramatically. Consequently, life in rural areas became unattractive to young people, setting in motion a mass exodus to urban centers and mining projects, creating a reservoir of unemployed youths and illegal diamond miners.

Similarly, the education system managed to accommodate less than 50% of school-aged children; school drop-outs had little or no vocational training and even graduates had few employment opportunities.

It is generally known that the civil conflict that had plagued the country for eleven years (1991 – 2002) with immeasurably catastrophic consequences for more than a whole decade served to enhance this dismal socio-economic and political landscape.

Institutions and public services were largely centralized and the national budget was presented in the capital, Freetown. However, much of the centralized system is now gradually changing with the implementation of the Local Government Act of 2004. The Act created institutions such as the National Decentralization Secretariat.

Sierra Leone is one of the poorest countries in the world; in 2004, it was at the bottom of the human development index. According to the global human development report, in the period 1990 to 2002, 57% of the population lived below US $1 per day and 75% lived below US $2 per day. An estimate by the United Nations Country Team has suggested that some 82% of the population lived below US $1 a day in the same period (United Nations Development Assistance Framework, March 2003). Life expectancy declined from 42 years in 1990 to 34 years in 2000 and has only now crept back up to 40 years. Adult literacy at 31% is one of the lowest in the world and is much lower for women; only 18% of women can read in English compared with 35% of males, and only 19% of women can perform written calculations compared with 37% of males. Further details on the general situation in Sierra Leone are shown in Table 1.1.

Table A1-1: Sierra Leone Information

Characteristic	**Facts/ Description**
Population	5.6 million (Central Statistics Office projections 2001)
Natural resources	Diamonds, rutile, bauxite, iron ore, gold, chromite, timber and fish
Birth rate	45 births / 1,000 population
Death rate	19 deaths/ 1,000 population
Infant mortality	170/ 1,000
Under 5 Mortality	286/1,000
Maternal Mortality	1,800/ 100,000
Life expectancy	37 years

Ethnic groups	20 native African tribes (Temne 30%, Mende 30% others 40%
Religions	Muslim 60%, Christian 30%, indigenous beliefs 10%
Literacy	31.4%
Economic growth	5.4% (2001)
Total external debt	US $1.45 billion (June 2002)

Source: National Recovery Strategy, Sierra Leone (2002-2003)

The country is divided into four distinct regions: the Western Area and three provinces (East, North, and South), (see Table 1.2). The provinces are sub-divided into twelve (12) districts (see Table 1.2) which comprise 148 municipalities or chiefdoms. As indicated above, the provinces are divided into twelve districts, with each province headed by a Minister of State and, at the administrative level, by a Provincial Secretary (PS) who handles all administrative activities of the districts including the chiefdoms.

The district is administered by district council representatives (counselors) who are directly elected by their constituents. The council is a local government representing the central government at the district level. The head of the district council is the Chairman of the council. Representation in this council varies according to the size and population of a particular district.

The districts are divided into chiefdoms or municipalities with the exception of the western area. The municipality or chiefdom is the smallest administrative unit recognized by the central government. It is an area usually occupied by a distinct ethnic group, officially recognized as the traditional owners of that area. Other ethnie groups may and do settle there and consider it their natural home, but the ownership of a particular ethnic group and in few cases a combination of particular ethnic group(s) is recognized, both traditionally and by common law.

Each of the 148 municipalities or chiefdoms is governed by a Paramount Chief and a council of elders selected from important families, often corresponding to the ruling houses or class.

Table A1-2: Sierra Leone Provinces, Districts and Number of Municipalities per District

Province	District	# of municipalities
Northern Province	Bombali	14
	Kambia	7
	Koinadugu	11
	Port Loko	10
	Tonkolili	11
Eastern Province	Kailahun	14
	Kenema	16
	Kono	14
Southern Province	Bo	15
	Bonthe	11
	Moyamba	9
	Pujehun	12

Western Area	Freetown and peninsular	4

The governing of chiefdoms by paramount chiefs is an age-old tradition emanating from the time when the colonial powers established a partnership in governance with the traditional rulers (Tejan Kabbah, 1996). The central government and traditional authority collaborate for the prosperity of the nation and the material well-being of the people in their municipalities.

The institution of chieftaincy in Sierra Leone, as in most other communities, according to Kabba, arose out of man's need for social order. Kabba has posited that when communities became large and more complex, it was no longer viable to administer social control along family lines. Hence, community members established and subjugated themselves to a form of governance. The institution of chieftaincy is deeply rooted in the political culture. It is for this reason that every government (either colonial or postcolonial) has not only relied on chiefs to help implement its policies, but has publicly pledged to uphold the institution. (Of course, the level of adherence to this pledge has varied considerably from government to government.) The institution of Paramount Chieftaincy is also entrenched in the current constitution. Thus it cannot be tampered with through the normal process of legislation. In this way, it has been guaranteed that Paramount Chieftaincy will remain a vital factor in the local governance system and in the development of Sierra Leone.

The Commonwealth Local Government Forum's country profile (2001) on local government in SierraLeone also states that:

- "Paramount chiefs, who may be male or female, are elected for life by chiefdom councillors, but may be removed from office by the government or the people, or may resign."
- "...The basic political unit of the chieftaincy is the 'section', made up of a number of towns or villages, headed by a section chief or sub-chief. The paramount chief has jurisdiction over the sections within the chiefdom."
- "Paramount chiefs and section chiefs form the political hierarchy, together with town chiefs and village headmen. In all chiefdoms one chiefdom councillor is elected by every 20 taxpayers in that chiefdom. Chiefdom councillors assist the paramount chief in the administration of the chiefdom and the dissemination of directives. Collectively they constitute the chiefdom council, presided over by the paramount chief."
- "...Traditional leaders have a number of formal inputs into governance matters. At the national level, as members of parliament, they contribute to the policy debate. Paramount chiefs have an advisory role through the National Council of Paramount Chiefs (NCPC) established in October 2003. At the local level in the three provinces (North, East and South), paramount chiefs are represented on the district and town councils, and are members of ward committees."

Sierra Leone is typical of many postwar countries in that the infrastructure has largely been destroyed. It is estimated by the United Nations Development Program (UNDP) project report for Sierra Leone (June 2000) that during the period from June 1992 to December 1998, approximately 1 200 000 people became internally displaced, while about 500,000 became refugees in neighboring countries. Over the same period,

3,000 towns and villages, 2 100 educational facilities, 400 health posts and 3 000 water wells were reported to have been destroyed. Furthermore, the destruction caused during period from December 1998 to January 1999 saw, for the first time, a crisis in which warfare spilled into the heart of major urban centers, including the capital city, Freetown. Figure 1.2 indicates categorization of destruction levels on the infrastructure by district.

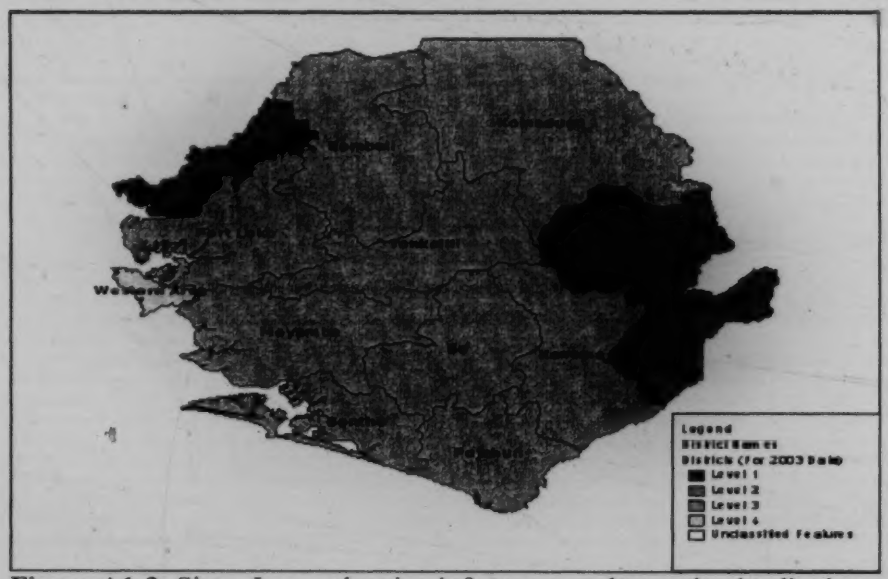


Figure A1-2: Sierra Leone showing infrastructure destruction by district

The destruction encompassed all categories of infrastructure to varying degrees. Level 1 indicates heavily devastated districts, followed by Levels 2-4, with Level 4 being the least affected An analysis of current infrastructure status in municipalities (OCHA/SLIS, 2003) reveals that less than 20% of the public infrastructure (i.e., schools, health centers, roads, markets, court barriers, administrative buildings, police stations, prisons, etc.) survived the war; and that the few assets which remain are in deplorable condition. Generally the funds to replace devastated infrastructure in reconstruction development schemes, is mostly derived from the outside, i.e., the donor community, rather than the local government.

In the education sector, a survey conducted by the National Commission for Resettlement, Reconstruction, and Rehabilitation (2001) has shown that the destruction to educational facilities included 1,270 primary schools, 820 secondary, tertiary and vocational schools, three teacher training colleges and one university college.

In the health sector, all provincial hospitals were affected. In districts such as Kambia, Tonkolili, Kono and Kailahun (see Figure 1.2), the hospitals were completely destroyed; other districts suffered considerable damage. Secondary health care service has also dramatically worsened in most of these regions. Secondary health services are delivered in rented properties in some of these districts. The availability of water and sanitation facilities is also extremely limited at this time. When access to most districts was regained between mid and late 2001, it was determined that only 20% to 35% of

water needs were being met for the various districts. The massive resettlement that has taken place in most of these districts since 2002 further compounds the problem.

Institutions administering civil authority in the districts were also targeted. Buildings housing the district agricultural offices, district councils, lands and housing, magistrate courts, national elections commission, prisons, police stations, public works departments, social welfare, and youth and sport offices all suffered extensive damage or destruction. In terms of transportation, the road network is in poor condition, particularly feeder roads. The appalling state of roads has also served to bottleneck the transportation system as a whole, making it difficult for goods and services to reach people from across the country. River transportation was also adversely affected as landing sites (jetties) and associated facilities for storage and provision of temporary shelter for travelers were either destroyed or became deteriorated due to years of abandonment.

Reconstruction of destroyed infrastructure facilities is vital to the improvement of citizens' quality of life. It is the physical framework that supports and sustains all economic activity and produces services central to the quality of life (Grigg, 1994; Cain, 1997). Therefore, efforts to systematically address this situation in Sierra Leone are progressing. Prior to the outbreak of war in 1990, and as a result of a continual decline in the standard of living of the citizenry, the Government of Sierra Leone had entered into IMF/World Bank supported programmes to help remedy the situation. This trend continues as part of the country's postwar reconstruction process, with a large number of donors and NGO institutions in support of it (see Appendices 2 and 3).

Following the period from the 1970s extending into the first half of 1980s, the economic and social conditions of Sierra Leone deteriorated sharply. The scenario has changed little since the outbreak of fighting in 1991, and the contributions of the Government of Sierra Leone and various donor agencies towards replacement of devastated infrastructure have been grossly inadequate. Table 1.3 exhibits this disparity.

Funding budgets have often turned out to be mere "shopping lists" offering token allocations of funds barely sufficient to start a reconstruction programme. Some of the projects have not been based on the needs of the beneficiaries and have thus been manifest as "white elephant projects."

Table A1-3: Financial requirements, commitments, and short falls

Objective	Financial Requirement (US$)		
	Total	Commitment	Short fall
• Extension and consolidation of state authority	12,262,855	3,120,930	9,141,925
• Development of district officials, including representative line ministries (health, water and sanitation, education, and agriculture)	5,535,210	761,000	4,874,210
• Strengthening the Sierra Leone Police Force (training and deployment)	1,870,600	1,095,000	775,600
• Justice of the peace functionary and magistrate courts reestablishment	761,500	50,000	711,500
• Priority prisons	2,193,845	752,930	1,440,905
• Court barriers rehabilitation	1,801,700	462,000	1,339,700
• Rebuilding schools, health care centers, water and sanitation	59,184,550	29,746,500	34,874,500
• Additional primary schools, secondary and technical vocational training	15,450,000	6,950,000	8,500,000
• Shelter assistance at least 20,000 houses (rehabilitation)	10,000,000	0	10,000,000
• Sensitization on Human rights and mediation: Communities and government personnel	1,947,000	704,000	1,243,000
• Agriculture- provision of seeds and tools, life stock, fishing	30,727,000	10,000,000	20,727,000
• Improvement in the road network in critical areas (trunk roads-3 980 km; feeder roads-2 990 km).	107,000,000	72,300,000	34,700,000
• Micro-financing: targeting 20,000 clients	1,150,000	0	1,150,000

Source: OECD, PRSP, 2005, IMF 2004, UNAMSIL URL

Appendix 2: Donor Agencies in Sierra Leone

Sierra Leone shows clear and practical evidence of the international and donor communities' major involvement in postwar reconstruction in Africa. Donor funding either in the form of loans, grants, or credits is not a new concept in Sierra Leone; it dates back to the early days of independence when the economy was robust. This trend continues today and is currently at a stage where the country is regarded as a donor-driven or donor-dependent economy. Table 1.4 shows Government of Sierra Leone and donor funding expenditures between 2002 and 2004.

Table A2-1: Comparison of International and Government Expenditures (US$ Million)

Funding Category	2002	2003	2004
Overseas Development Assistance	353	303	360
United Nations Mission in Sierra Leone *	617	603	449
Government of Sierra Leone	240	256	338
Gross National Income	936	1010	1080

* Fiscal year rather than calendar year
Source: OECD, PRSP, 2005, IMF 2004, UNAMSIL URL

The financial scale of international intervention considerably exceeds government expenditure.

About half of government services are financed from abroad. While the focus of funding is on donor aid, Moore (1996) has noted a disparity between appeals versus actual payments made. The author has further discussed the poor configuration of donor and UN funds with respect to meeting real needs in reconstruction. Hence, funds for reconstruction and rehabilitation are inadequate, and reconstruction efforts tend to rely on what can be made available. Meharg (2004) has lamented that although cases of international intervention are noble, their efforts at reconstruction can have long lasting negative impacts on recipient populations. This is because the interveners do not intend or wish to remain in war-torn societies beyond the extent of their mandates. Another issue Meharg has noted is that the reconstruction is sometimes carried out by outsiders who do not understand the culture in which they are intervening. Kaldor and Vincent (2006) have concluded that "despite the efforts to reconstruct the devastated country the legitimacy of Government remains weak" (p. 21). The reasons suggested by the authors are generally related to corruption, a collapse of the legal system, poor service delivery (especially basics like water, electricity, transport, and education) and a lack of transparency.

The National commission for Social Action (NaCSA), charged with the responsibility of coordinating donor activities, is often faced with problems of donors' differing interests, with each insisting on their own particular objectives. Hence, the aims of these international financial institutions, donor governments, and humanitarian agencies with respect to their assistance to devastated countries and communities seems simply to have added to the confusion by masking contradictory aims under the banner of a common rhetoric (Barakat, Chard, 2002). As a result of the confusion in purpose between donors and government agencies, postwar intervention in Sierra Leone has been described as "unsuccessful", although evaluators have not identified a means of

quantifying this effect. In such cases, negotiations with donors become a critical administrative skill required in order to initiate certain programmes and achieve results.

Lead Donor Agencies in Sierra Leone. The main donors involved in Sierra Leone's postwar reconstruction are the European Union (EU), The Asian Development Bank (ADB), African Development Bank (AfDB), Department for International Development (DFID), United States Agency for International Development (USAID), and bodies of the United Nations (UN) system. These organizations are supporting various activities ranging from emergency-oriented relief to development assistance.

The Asian Development Bank (ADB). The ADB's mandate as stipulated in Article 1 (p.3) of the agreement establishing the bank is to: "contribute to the economic development and social progress of its regional members - individually and jointly." The Bank's mission, therefore, is to assist Regional Member Countries (RMCs) (of which Sierra Leone is one) to break the vicious cycle of poverty in which they are entrapped. Working towards this goal, the Bank would endeavor to facilitate and mobilize the flow of external and domestic resources (public and private), promote investment, and provide technical assistance and policy advice to RMCs.

The African Development Bank. The bank is a multilateral organization whose institutional aim consists in fomenting economic development and social progress in the African continent. The African Development Bank Group is a multilateral regional development institution composed of 77 member countries in Africa, America, Europe and Asia. The aims of the African Development Bank Group are:

- to contribute to the individual or collective economic development and social progress of the regional member countries;
- to use the available resources for the financing of investment projects and programmes, giving precedence to projects that involve several member countries;
- to mobilize resources through co-financing with bilateral and multilateral development bodies;
- to foment, at the international level, dialogue and consultation on issues related to the development of Africa;
- to encourage public and private investment in Africa by carrying out the appropriate reforms;
- to lend the necessary technical assistance in the selection, examination, and preparation of development projects for the African continent.

Department for International Development (DFID) (Excerpts from DFID website, August 8, 2007). The Department for International Development (DFID) is the UK government department responsible for promoting development and the reduction of poverty. The British Liberal government first elected in 1997 has continued to increase its commitment to development by strengthening the department and increasing its budget.

The central focus of the Government's policy, set out in the 1997 White Paper on International Development, is a commitment to the internationally agreed upon target to halve the proportion of people living in extreme poverty by 2015, together with a commitment to reach associated targets, including basic health care provision and

universal access to primary education, by the same date. A second White Paper on International Development, published in December 2000, reaffirmed this commitment, while focusing specifically on how to manage the process of globalization to benefit poor people.

DFID seeks to work in partnership with governments committed to these targets, and seeks to work with businesses, civil society, and the research community to this end. DFID also works with multilateral institutions, including the World Bank, United Nations agencies, and the European Community.

The majority of DFID's assistance concentrates on the poorest countries in Asia and sub-Saharan Africa. DFID also contributes to poverty elimination and sustainable development in middle-income countries in Latin America, the Caribbean, and elsewhere. Additionally, DFID also assists the transition countries in Central and Eastern Europe to ensure that the process of change brings benefits to all people, focusing particularly on the poorest citizens.

European Humanitarian Aid Office (ECHO) (Excerpts from EUROPA website, August 8, 2007). ECHO does not intervene directly on the ground. The assistance it provides is mainly mobilized and implemented by its partners in accordance with ECHO's general strategic guidelines. ECHO works with over 200 non-governmental organizations, United Nations agencies, and international organizations such as the International Committee of the Red Cross, the International Federation of the Red Cross, and the Red Crescent Societies. This diverse range of partners allows ECHO to cover a comprehensive range of an ever-growing list of needs in different parts of the world – and in increasingly complex situations. ECHO provides support for health facilities, water and sanitation, shelter support, as well as protection of populations at risk.

European Commission (EU) (Excerpts from Bukhard Kriste, 2007). The dual mission of this EU commission is to help to reduce and ultimately to eradicate poverty in developing countries while simultaneously promoting sustainable development, peace, and security. Their role is to initiate and formulate a community development cooperation policy for all developing countries as defined in Title XX of the Treaty establishing the European Community. They also coordinate the Community's relations with sub-Saharan African, the Caribbean, and Pacific countries (ACP), as well as the Overseas Countries and Territories (OCT).

Office of U.S. Foreign Disaster Assistance (OFDA) (Excerpts from USAID Policy, 2004). The mission of OFDA is to save lives and alleviate human suffering. OFDA provides and coordinates effective, appropriate, and efficient assistance for those affected by natural and human disasters. It is the office within the United States Agency for International Development (USAID) responsible for facilitating and coordinating U.S. Government emergency assistance overseas. The OFDA responds to all types of natural disasters, including earthquakes, volcanic eruptions, cyclones, floods, droughts, fires, pest infestations, and disease outbreaks. It also provides assistance when lives are threatened by accidental or human-caused catastrophes such as civil strife, acts of terrorism, or industrial incidents. In addition to emergency assistance, the OFDA funds mitigation

activities to reduce the impact of recurrent natural disasters as well as training activities intended to increase a country's capacity for local disaster response and management.

United States Agency for International Development (USAID). USAID's history goes back to the Marshall Plan for the reconstruction of Europe after World War II and the Truman Administration's Point Four Program. The USAID has been the primary U.S. agency to extend assistance to countries recovering from disaster, seeking to escape poverty, or engaging in democratic reforms. It is an independent federal government agency that receives overall foreign policy guidance from the Secretary of State. The agency works to support long-term and equitable economic growth and advances U.S. foreign policy objectives by supporting:

- economic growth, agriculture, and trade;
- global health; and
- democracy, conflict prevention, and humanitarian assistance.

The USAID provides assistance in four distinct regions of the world:

- Sub-Saharan Africa;
- Asia and the Near East;
- Latin America and the Caribbean, and;
- Europe and Eurasia.

World Bank (Excerpt from: Dana Clark, 1999). The World Bank is an international financial institution created in the wake of World War II with a mission to provide loans and credits to developing countries for projects which alleviate poverty and promote social and economic development. World Bank activities have focused on sectoral programs and projects in the agriculture, education, infrastructure, and health sectors. The aim of the Bank's assistance strategy is to offer technical support and non-regular financial assistance to spur on reconstruction and recovery efforts in war-devastated countries. Its focus has been to provide

- assistance in designing reconstruction and recovery programs;
- policy advice with regard to economic management, including the bolstering of government institutions;
- selective financial assistance for reconstruction and economic re-start activities,
- support of government budgets and institutions; and
- initial transition and social reforms.

As a concluding remark, the role of international donor agencies in governance and state building, according to Jenkins and Plowden (2006), has been hampered with regard to the success of postwar reconstruction. Jenkins and Plowden have discussed issues related to the role of existing institutions, the history of postwar countries, and the significance of culture that could yield significant answers and new strategies as to the restructuring of international interventions. They argue that there is some inconsistency that exists in donors' respective spheres of influence. This is largely due to the ambiguity that exists in their aims and objectives and the oversight of grave social conditions such as apartheid and corruption when initiating aid (Jenkins and Plowden, 2006, 32).

Donor organizations provide most of the resources in postwar reconstruction in developing countries such as Sierra Leone, as was discussed above. However, due to the restrictive conditional requirements set by donors – structural adjustment programs are often tied to aid, for example – the relationship between donors and recipients is soured (Jenkins and Plowden, 2006- 32).

Problems also arise when a country receives aid from multiple donors since some donors may have conflicting aims and objectives as to how to institute public sector reform. Examples include Congo Democratic Republic, Somalia, Cambodia, Sierra Leone, Mozambique, Tanzania, Zambia, to name a few, where over fifty bilateral donors operate; and each requires individual management relationships (Quartey, 2004; Jenkins and Plowden, 2006). Jenkins and Plowden have drawn a parallel reasoning to this: "this is like having 50 girlfriends or boyfriends in some sense and having to heed to each of their wants in order to maintain the relationship."

Difficulties may also arise in the implementation process, when contracts are finally negotiated. The teams employed on projects (which include no local citizens and whose members may not speak the local language of their clients) may know little or nothing of the history or culture of the country in which they work (Jenkins and Plowden, 2006).

In conclusion, donors expend a great deal of capital in their aid efforts, and thus it is important that they are aware of possible errors so as to mitigate their efforts in future commitments. Jenkins and Plowden have argued, however, that most of the evaluation processes of donors are insufficient and thus create a situation where learning is limited. The authors have noted that projects do not need elaborate analysis but instead require an awareness of what is happening (based on evaluation) in order to make their aid efforts successful.

Appendix 3: International NGOs Operating in Postwar Sierra Leone

Role of Non-Governmental Organizations. The participation of NGOs in national development efforts in Sierra Leone dates back to the early 1960s. Religious bodies took the lead in stimulating development activities at the grassroots level with the active participation of local citizens. Increased awareness of the vital role of NGOs has continued to attract local, private, and public donations as well as international donor funding for implementing specific activities throughout the country since the 1970s. A consultative forum in 1994 resulted in the formulation of the NGO policy document.

However, the 1980s witnessed a steady increase in the number of NGOs operating in Sierra Leone as bilateral and multilateral agencies shifted their aid strategy to channel resources directly to beneficiaries through grassroots organizations. The large influx of Liberian Refugees and internally displaced Sierra Leoneans in the 1990s also contributed to the proliferation of both national and international NGOs undertaking Relief and Development activities with mixed results. At the same time, ineffective coordination, monitoring, and evaluation mechanisms have made it difficult to assess the impact of the variety of interventions, duplication of efforts, and the associated benefits for the country.

While the Government of Sierra Leone (GOSL) recognizes the valuable role NGOs play in promoting national development, both parties must work closely to ensure mutual trust, confidence, and transparency. The increasing demand by NGOs for GOSL counterpart contributions in the form of grants, waivers, and other logistical contributions including storage, transportation, and personnel, gives cause for a rationalization of their activities. The Ministry of Development and Economic Planning (MODEP) is the GOSL agency mandated to coordinate and monitor the activities of both national and international NGOs and to enhance the cooperation between the GOSL and NGOs. The absence of a systematic and effective operational guide or framework to regulate the operations of NGOs since the commencement of effective postwar reconstruction has put pressure on the MODEP to develop policy guidance for NGOs.

The Sierra Leone Association of Non-Governmental Organizations (SLANGO) was formed as a result of the proliferation of NGOs in Sierra Leone. Its mandate is to foster effective mobilization and integration of NGO intervention in the development process of Sierra Leone by providing a mechanism for coordination. This addresses the need for a national coordinating entity so that NGO interventions in the national re-development / reconstruction process are coordinated to avoid duplication of efforts and to work toward a more meaningful and sustainable impact.

Table A3-1: NGOs Operating in Sierra Leone

#	NGO Name	Source of Fund	Objective	Activities
1	Action Countre La Faim (ACF)	ECHO; DGDCV; EU; OFDA.	Fighting against hunger by targeting most vulnerable	▪ Education: reconstruction of schools ▪ Water and sanitation: Construction of water wells; latrines ▪ Health: Hygiene education, therapeutic feeding centers ▪ Agriculture: Seeds and tool

				distribution; vegetable gardening
2	Action Aid	DFID; EU; WB; Comic relief.	Work with poor and marginalized people to eradicate poverty	▪ Shelter development: local building material production; reconstruction of residential homes ▪ Education: rehabilitation/ reconstruction of schools; teacher training; adult literacy ▪ Water and Sanitation: Water well construction/ rehabilitation, hand pump installation; ▪ Health: Health post and centers reconstruction, primary health care, mobile health clinics; ▪ Agriculture: seeds and tools, training, compositing and tree planting; ▪ Transportation: feeder road construction, bridge rebuilding.
3	Adventist Development and Relief Agency (ADRA)	UNHCR	Provide assistance in situations of crisis	▪ Education: Adult literacy; school reconstruction; teacher training; school supplies ▪ Health: reconstruction of health clinics; ▪ Relief: food distribution.
4	Action for Children in Conflict (AFC)	UNAMSIL; Japan women movement.	Work towards breaking cycles of violence among youths	▪ Capacity Building: skills training, girl literacy.
5	AFRICARE	WB; UNCF; OFDA; UNICEF.	Improve the quality of life in rural Africa	▪ Health: health posts/centers reconstruction, immunization, drugs supply, training; ▪ Water and Sanitation: construction and rehabilitation of wells,

				latrines, training on maintenance of water pumps; ▪ Agriculture: seeds and tools.
6	American Refugee Committee (ARC)	US Bureau for population Refugees and Migration; UN; UNHCR.	Facilitates reintegration and support to transition for war torn countries	▪ Health: training health workers; ▪ Capacity Building: Micro-credit program, housing and construction projects.
7	Care International	DFID; US Government; EC; Norway and Dutch Govts.	Addressing the root causes of poverty and suffering through capacity building, advocacy and partnership	▪ Water and Sanitation: Well construction and rehabilitation; ▪ Agriculture: Food security-seeds and tools provision; ▪ Capacity Building: Training; shelter support.
8	Caritas: Diocesan Development and Relief Agency	UNICEF CAFOD- Irean CORD Aid-Netherlands	Support the promotion of community people own development projects.	▪ Health: Family health care, reconstruction of health centers, training and support materials ▪ Education: School reconstruction and rehabilitation Teaching and learning materials ▪ Interim care centers
9	Christian Aid	UNICEF; Canadian public Health; ODA.	To assist marginalized groups in West Africa and Central America	▪ Health: Primary health care, immunization, psychosocial counseling, rehabilitation and reconstruction of health centers; ▪ Education: Rehabilitation of schools, teaching and learning materials; ▪ Capacity building: Skills training, start-up grants.
10	Children Associated with	Caritas-International;	To rehabilitate war affected	▪ Interim care centers: psychosocial and trauma

	War (CAW)	WRF ; UNDP ; WFP ; ICRC ; UNICEF.	children with a view to integrate them into society	counseling, career counseling, basic numeric classes, recreational activities/speeches, arts and culture; ▪ Family tracing: mediation and reunification; ▪ Education: Vocational and skills training, provision of school and support fees; ▪ Capacity building: Start-up kits, micro-enterprise development.
11	Christian Extension Service (CES)	Individual donations	To create permanent change in people's lives	▪ Distribution of used clothing, food for agriculture; ▪ Education: Reconstruction/ rehabilitation of schools; ▪ Health: reconstruction / rehabilitation of health centers; ▪ Water and Sanitation: Rehabilitation / construction of water wells; ▪ Evangelism: Bible story telling, literacy in church groups; ▪ Capacity building: skills training, micro-credit loan.
12	Concern World Wide	UNHCR; Ireland Aid; Concern General; Donations.	To enable absolutely the poor to achieve sustainable improvement in their lives	▪ Health: Primary health care; ▪ Education: reconstruction and rehabilitation of schools; ▪ Agriculture: seed banks, construction of drying floors;
13	Cooperazione Internationale (COOPI)	UNICEF; UNHCR; WHO; UNDF; EU/ECHO; Italian Govt.	To help the World's poorest to improve their quality of life	▪ Health: Rehabilitation and reconstruction of health centers; ▪ Education: reconstruction and rehabilitation of schools; ▪ Water and Sanitation: rehabilitation and

				construction of water wells, sewage system; ▪ Recreational Events: to raise awareness about poverty and war.
14	Conciliation Resources	UNHCR	To provide international service to local organizations pursuing peace building or conflict transformation initiatives	▪ Community based peace making initiatives; ▪ Support for peace-work with youths; ▪ Support media in conflict and peace reporting; ▪ Support for women peace initiatives.
15	Catholic Relief Service (CRS)	Catholic community in the US; Foundations; Individuals; Corporate and Student Groups; DFID; US Aid/OFDA.	Geared towards alleviation of human suffering, the development of people and fostering of charity and justice in the World.	▪ Education: school feeding, training in non-formal primary school curriculum, support on school gardening projects; ▪ Health: HIV/AIDS awareness, Rehabilitation and reconstruction of health centers and posts, maternal child health; ▪ Shelter/ Reconstruction: Housing reconstruction; ▪ Agriculture: Seeds and tools distribution; ▪ Peace Building: Training of trainees, trauma healing, reintegration of ex-combatants; ▪ Managing refugee camps.
16	The Environmental Foundation for Africa (EFA)	UNHCR Conservation International; Critical ecosystem partnership fund; Netherlands	To restore and protect the environment through environmental education and awareness raising	▪ Rapid environmental assessment in target areas; ▪ Intensive awareness raising ▪ Workshops, participatory appraisals and training; ▪ Building the capacity of community action groups; ▪ Training the domestic

		committee of World Conservation Union; Tropical rain Forest Program.		energy conservation; ▪ Construction of eco-system.
17	Forum for African Women Educationalist (FAWE)	International donations	To close the gender gap in education at all levels	▪ Scholarship programs for poor and needy girls in educational institutions in country ▪ Skills training centers ▪ Counseling services to female clients ▪ rehabilitation for sexually assaulted girls ▪ Non-formal education programs for out of school youths and female adults
18	Campaign for Development and solidarity (FORUT)	FORUT-Norway; Norwegian government; Agency for development; Norwegian Foreign Ministry.	Work with under-privileged by engaging in community mobilization, relief and rehabilitation.	▪ Education: school reconstruction and rehabilitation, construction of staff quarters, teaching and learning materials, peace education, skills training; ▪ health: training of health providers, construction of health posts, primary health care delivery system; ▪ Agriculture: provision of seeds tools and food for work; ▪ Shelter: Building material provision for reconstruction of residential homes; ▪ Economic Recovery: Micro-credit loan scheme; ▪Roads: Feeder roads reconstruction and rehabilitation, reconstruction of bridges.
19	COAL	UNICEF; Ireland Aid.	To ensure that poor and most	▪ Health: health promotion, primary health care;

			vulnerable have access to fundamental needs	▪ Water and Sanitation: provision of portable water.
20	German Technical Corporation (GTZ)	German ministry for Economic Corporation and Development; UNHCR; DFID.	To make sustainable improvements to living conditions of people in postwar countries, and to ensure the natural resource base in which life depends	▪ Socio-economic reintegration of ex-combatants and returnees; ▪ rehabilitation of social and economic infrastructure, community service and reconstruction; ▪ Support to agriculture and HIV/AUDS awareness raising.
21	Handicapped International	Handicapped International Association Fund; DDC/SWISS Cooperation; Omega Initiative; Matter 6 Foundation.	To build a sustainable network of competence and facilities that will enhance the integration, general wellbeing and promotion of the physically disabled and psychologically suffering population	▪ Promotion of artificial limbs ▪ Post-prosthetic training for amputees' use of calipers, splits, crutches, wheel chairs and their repairs.
22	Initiative pour Une Afrique Solidaire (AIS)	UNHCR	Provide assistance to returnees in terms of construction of social structures	▪ Education: School reconstruction and rehabilitation, adult training.
23	International	USAID;	To save lives,	▪ Health: Maternal and child

	Médical Corps (IMC)	Dutch Govt.; EFP; DFID; ECHO; UNICEF.	relief suffering and improve the quality of life.	health care; primary health care training and service delivery, reconstruction and rehabilitative surgery, medical logistics, rehabilitation of health centers; ▪ Water and Sanitation: Water well construction and rehabilitation.
24	International Islamic Relief Organisation (IIRO)	Saudi Arabian Government; UN/OCHA; UNICEF.	To respond to the needs of humanity as nations go through situations of war, persecution, natural and man-made calamities.	▪ Provide assistance to returnees: provision of food and non-food items; ▪ Construction of displaced camps; ▪ Education: Reconstruction of schools; ▪ Health: Reconstruction of health centers; ▪ Reconstruction of social infrastructure.
25	International Organization of Good Templar (IOGT)	WHO; WFP.	Controlling and prevention of drug, alcohol and other related substance use.	▪ Education: Reconstruction of schools; ▪ Health: Reconstruction of health centers; ▪ Reintegration: Skills training for ex-combatants; ▪ Roads: Feeder roads and bridge reconstruction.
26	International rescue Committee (IRC)	UNHCR; UNICEF; DFID; CAUSE Canada; OFDA ; ECHO.	Provide assistance to people fleeing racial, religious and ethnic persecution, as well as those uprooted by war, violence and natural disasters.	▪ Health: Critical medical and public health services, reconstruction of health centers and clinics; ▪ Education: Reconstruction of schools; ▪ Water and sanitation: Construction of water wells, latrines, ▪ Socio-economic reintegration: Reunification 7 reintegration programs, family tracing, income generating (micro-credit

				loans).
27	Life for Relief and Development	UNHCR ; Donations.	Provide humanitarian assistance to poor and needy people.	▪ Education: Donation of educational materials, skills training; ▪ Health: medical facilities donations.
28	The Lutheran World Federation (LWF)	UNHCR ; UNICEF ; DFID ; EU.	Relief supplies and rehabilitation activities for those in crisis.	▪ Education: Primary school reconstruction, distribution of educational materials; ▪ Water and Sanitation: Construction and rehabilitation of water wells; ▪ Transport and logistic support to IDPs and returnees; ▪ Agriculture: Supply of tools and seeds to farmers.
29	Marie Stopes Society	DFID ; UNICEF ; UNFPA.	To provide low cost reproductive health care to low-income and their families so as to improve quality of life of people.	▪ Reconstruction of reproductive health care centers; ▪ Rehabilitation of victims of torture; ▪ Emergency obstetric.
30	Mercy Ships	Swedish Mission Council ; Tears Fund UK.	To address root causes of poverty and social exclusion by empowering.	▪ Rehabilitation; ▪ Prosthetics and Orthotics; ▪ Surgeries and dental clinics; ▪ relief activities ▪ Construction with volunteers; ▪ Reintegration for disabled children in school; ▪ vocational training and work placement schemes; ▪ Water and sanitation: Construction and rehabilitation of water wells.
31	MERLIN	DFID/UK;	Provide an	▪ Health: Primary health care,

		ECHO; OFDA; BUZA; Rockefeller foundation.	immediate and effective response to medical emergencies and support to basic health care.	reproductive health, drug support, counter-parts with national health staff.
32	Medecines Sans Frantieres (MSF)	Governments of France, Holland and Belgium.	Offers assistance to populations in stress, victims of arm conflict.	▪ Health: Primary health care, nutrition, secondary health care, operational research on malaria.
33	Norwegian Refugee Council (NRC)	Norwegian Ministry of Foreign Affairs; UNHCR; DFID; EC; WFP.	Works to promote the right of refugees and internally displaced persons (IDPs).	▪ Education: rehabilitation and reconstruction of schools, educational support; ▪ Health: Reconstruction and rehabilitation of health centers; ▪ Construction and management of camps.
34	Oxfarm, Great Britain	Oxfarm International; UK Government; OFDA.	Works with others to overcome poverty and suffering.	▪ Water and Sanitation: Rehabilitation of water wells, construction of latrines, training of sanitary personnel.
35	Peace Winds, Japan	Japanese Government.	To provide international assistance to people who are victimized by political circumstances and natural disasters.	▪ Education: Construction of schools, literacy training; ▪ Health: Emergency assistance, construction and rehabilitation of health centers, medical assistance; ▪ Social Services: Income generation, vocational training, rehabilitation and reconstruction of health centers, shelter; ▪ Camp management ▪ water and Sanitation: construction of water wells; ▪ Agriculture: Anti-pest assistance.

36	Plan- Sierra Leone	Grants; Ministry of Education- Sierra Leone; Forum for African Women's Educationalists (FAWE)	Works to improve the lives of children and their communities and aims to assist people in breaking out of the cycle of poverty.	▪ Education: Rapid education (teacher training) sponsorship, school rehabilitation and reconstruction; ▪ Trauma counseling and peace education; ▪ Health: Health and hygiene education; ▪ Water and Sanitation: Construction and rehabilitation of water wells; ▪ Institutional development.
37	Premiere Urgency	DFID; EC; USAID	Contribute to the return and reintegration of internally displaced and repatriated persons.	▪ Rehabilitation of private housing for refugees and displace persons; ▪ Education: reconstruction and rehabilitation of schools; ▪ Health: Rehabilitation and reconstruction of clinics; ▪ Social Services: Micro-credit loan, emergency aid.
38	Save the Children (UK)	DFID.	To create a better World for children in the area of child protection.	▪ Caring for abandoned or orphaned children in family homes; ▪ Interim care centers for child solders.
39	Tear Fund	UNHCR	Provide rapid and competent operational relief response to major disasters.	▪ Education: School reconstruction and rehabilitation; ▪ Water and sanitation: Construction and rehabilitation of water wells; ▪ Health: Public health education.
40	TERRA TECH	Membership fees; Private donations; German line	Active in emergency response and development programmes.	▪ Health: construction of health facilities; Water and Sanitation: Construction and rehabilitation of water wells,

		ministries; EC.		training of well attendants.
41	War Child (Holland)	Donations; Holland line ministries.	To deliver creative workshops, counseling, etc, to help children and adolescents living in postwar conflict areas with their psychosocial problems.	▪ Music workshops; ▪ Arts; ▪ Sports.
42	World Hope International (Sierra Leone)	World Hope International (USA and Canada)	Transform lives of the depressed.	▪ Education: Support to community schools; ▪ Health: Health care services, fitting of limbs; ▪ Water and Sanitation: Construction of wells and VIP toilets; ▪ Social Services: Women skills and training, micro-credit financing; ▪ Agriculture: Food and aid intervention, produce marketing services.
43	World Relief	US consortium of churches; DFID; EFSL; UNHCR; WB; BPRM.	Restoring hopes of people through ministries that address poverty, disease, hunger, persecution and effects of war disasters.	▪ meet suffering people's physical environmental and spiritual needs; ▪ Apprenticeship and skills training; ▪ Agriculture: Life stock restocking, seeds; ▪ Education: School reconstruction; ▪ Health: Immunization, reconstruction of health clinics; ▪ Water and Sanitation: Sinking of water wells.
44	World Vision	UNHCR	Provide	▪ Agriculture: Life stock

	development that is community based and sustainable, especially on the needs of children.	restocking, seeds, planting of trees; ▪ Education: School reconstruction; ▪ Health: Immunization, reconstruction of health clinics; ▪ Water and Sanitation: Sinking of water wells.

Appendix 4: Sierra Leone Decision Making Structure and Process

It is important to understand the organizational structures and processes under which postwar reconstruction occurs. The Ministry of National Reconstruction, Resettlement and Rehabilitation (MNRRR) was created in 1996 after the opening of the first session of Parliament to coordinate the government programme addressing devastation caused by war. Due to the nature of the program, which requires quick decision-making and minimal bureaucracy, in March 1998 the Government transformed the Ministry (MNRRR) to a National Commission for Reconstruction, Resettlement and Rehabilitation (NCRRR).

In 2001 this body was again transformed, renamed the National Commission for Social Action (NaCSA). Figure 1.3 illustrates the NaCSA's structure for Sierra Leone postwar reconstruction and the coordination of programme activities.

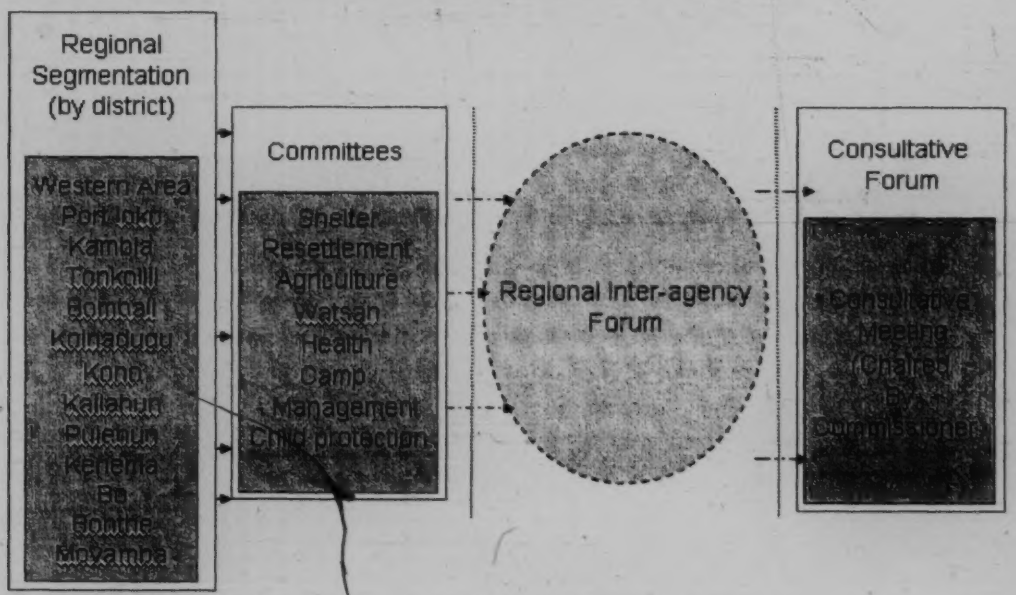


Figure A4-1: NaCSA Project Evaluation and Coordination Structure

The NaCSA formed separate committees under the various categories of infrastructure (shelter, education, health, etc.) for each district. The various sectors or committees meet at a regional level (regional inter-agency forum) to coordinate post-conflict programmes. The needs of municipalities are discussed in the inter-agency forum on a monthly basis. A consultative forum, chaired by the NaCSA commissioner, is held quarterly. In the consultative forum, the commissioner receives operational feedback from all sectors responsible for the respective infrastructure categories. This forum provides the foundation for policy orientation on post-conflict interventions across the country.

The next section discusses the organizational structure and process following effective formulation of a reconstruction framework, 1998-2007.

Operational structure of Sierra Leone Postwar Reconstruction. The NCRRR was charged with the following mandate:

- to be responsible, on behalf of the government, for the overall planning, programming, coordination, supervision, and monitoring of all humanitarian, resettlement, and reconstruction work necessitated by the rebel war;
- to coordinate the activities of all NGOs engaged in relief, rehabilitation, resettlement and reconstruction work in consequence of war;
- to ensure that activities of implementing partners (including international community-based organizations [CBOs]) are in conformity with the National Reconstruction, Resettlement, and Rehabilitation Programme (NRRRP) of the Government;
- to design an operational and procedural framework that will be credible and flexible enough to facilitate effective collaboration and coordination among government departments and other partners;
- to establish a separate Financial Management and Procurement Unit (PMPU) to ensure appropriate use of donor resources (where applicable) in a transparent manner for reconstruction, resettlement, and reintegration; and
- to ensure that all implementing partners submit periodic reports of their activities to the commission.

The commission is viewed by the government as the principal instrument to support the consolidation of peace and lay the foundation for longer term development. Four main Project Implementation Units (PIUs) (sometimes referred to as funding windows) were established by the Commission in partnership with various donors to carry out demand-driven projects through various implementing agencies such as line ministries, local and international NGOs, CBOs, and private contracting firms. The projects covered include health, education, community infrastructure, water and sanitation, agriculture, capacity building, and resettlement.

The PIUs under the commission are:

- the Emergency Recovery Support Fund (ERSF), jointly funded by the GOSL, the World Bank, and the African Development Bank;
- the Social Action and Poverty Alleviation (SAPA) Programme; jointly funded by the GOSL and the African Development Bank;
- the Integrated Rural Development Programme (IRDP); jointly by the GOSL and the Islamic Development Bank; and
- the Support to Resettlement and Reintegration Program (SRRPP; jointly funded by the GOSL and the United Nations Development Program (UNDP).

At the conclusion of the NCRRR mandate (2001), the necessity was apparent of continuing the reconstruction work facilitated by the NCRRR to improve the deplorable situations of people devastated by war and to honor the government's obligation, but with a renewed mandate. The creation of the NaCSA allowed a smooth transition. Additional

staff personnel were recruited to meet the demands of the new mandate, reporting lines, and the additional (new) departments in the institution.

NaCSA was established by an act of parliament (National commission for Social Action Act, 2001, No. 3) passed on November 5th, 2001, as a successor to the NCRRR. It operates a portion of its donor resources along the lines of a social fund. Its mandate includes the following elements:

▪ to promote community-based, demand-driven, sustainable development activities leading to the alleviation of poverty and improvement in the speed, quality, and impact of development initiatives in cooperation with NGOs, CBOs, relevant ministries, private sector partners, and other interested parties;

▪ to assume, on behalf of the government, all the functions of the NCRRR during the transition period, including overall planning, coordination, supervision, and monitoring of all humanitarian, reintegration, resettlement, and reconstruction activities so as to improve the nation's capacity to effectively absorb and utilize relief and development assistance;

- to maintain itself as a sustainable national institution for the purpose of promoting community-based, demand-driven, sustainable development;
- to ensure appropriate use of donor resources in a transparent manner;
- to undertake public education campaigns with regard to its purposes and procedures;
- to instigate such activities as will contribute to the attainment of sustainable development;
- to seek funding from donors to finance activities in coordination with relevant line ministries and other departments; and
- with the approval of the board, to develop and adopt an operational and procedural framework setting out the policies and procedures of the commission and criteria for the selection of sub-projects and information on other procedural, management, financial, and administrative arrangements it considers necessary for the efficient utilization of its funds.

The four funding windows of NCRRR (i.e., ERSF, SAPA, IRDP and SRRP) were compressed to three: the Community-Driven Programme (CDP), the Public Works Programme (PWP), and the Micro-Finance Programme (MFP).

In summary, NaCSA is viewed by the GOSL as the principal instrument for postwar reconstruction, laying the foundation for development initiatives in the country. This perspective is informed by virtue of the NCRRR's demonstrated ability to support war-affected communities using a decentralized partnership approach to reconstruction involving line ministries, NGOs, and civil society (World Bank Project Appraisal Report, 2003). According to NaCSA senior officials, this has been manifest in the successful implementation of its portfolio of projects and the confidence and trust that the donors and its partners have in the organization. Its marked success may have been related to its institutional arrangements: i.e. staffing, organizational structure, reporting lines, and activities of the various windows (NaCSA, mid year review, 2006). Its may also be understood in light of the fact that the NaCSA was created at a time when no other

institution in the country could have been regarded as capable enough to implement projects in the robust and timely manner necessitated by the situation.

Projects Selection Process. The criteria used in the selection of projects for the reconstruction vary according to organizational needs, culture, mandate, and relative importance as perceived by executives. The NaCSA, the UNDP and the DFID, in particular, vary remarkably in their selection criteria:

Executives of these funding agencies primarily select projects on the basis of organization policies or existing problems, in which case projects are selected based on the immediate goal of reconstruction initiatives. In either situation, the views of the senior management or executives are a strong indicator of project selection and are weighted highly in the overall project selection process.

At the beginning of reconstruction, the NaCSA's project selection procedure had been based on choosing infrastructure facilities for reconstruction in municipalities from a pre-assessed needs list. As can be imagined, this methodology is for the most part highly influenced by politicians and other influential figures. The negative effects associated with this rather arbitrary selection of facilities led the commission to adopt the concept of the "social fund" in their project selection initiatives.

Social funds were originally set up in Latin America as emergency response mechanisms (White, 2001) to counteract the negative effects of crisis on the social sector and to mitigate the effects of structural adjustment policies. This has now shifted toward long-term development impact and institutional development objectives, e.g., provision of long-term infrastructure. The first social fund was established in Bolivia in 1986, and quickly proved to be efficient both in job creation and in the provision of revenues for the poor (Rollings et al., 2004).

White (2001) defines the social fund as "decentralized mechanisms by which the World Bank's funds are made available to an autonomous institution whose role is to finance the investment needs of the population, expressed by their groups, local associations, or NGOs on the field" (p. 13). As affirmed by White, these funds are generally multi-sectoral mechanisms which finance projects aiming at improving access to social services (education, health, water and sanitation, etc.), creating employment opportunities or generating revenues for the poorest populations, and undertaking small community investments (like small urban works, community centers, rural wells, water distribution, rural roads, etc.).

In further regard to the concept of social fund, a World Bank Operations Evaluation Department (OED) report (2002) has highlighted that poor people are allowed to become actively involved in the development of their communities through social funds. With social fund financing and technical assistance, communities identify their own development priorities, hire contractors, manage project funds, and, upon construction completion, manage and sustain the sub-project. Communities set up financial mechanisms that depart from traditional approaches to development, which had been led by the central government *enabling* communities and local institutions and in which central governments had taken the lead in identifying and carrying out community-level investments. The fund is designed to respond to crises and to the perceived ineffectiveness of many traditional top-down project allocation procedures. According to the International Bank of Reconstruction and Development of the World Bank (2002), social funds attempt to implement a bottom-up model of locally generated initiatives.

Currently, the NaCSA responds to requests generated by local groups, appraises projects for funding, supervises implementation of projects, and monitors their effectiveness. Projects are selected by a project management committee comprised of NaCSA representatives and members of the local community. This committee assesses a communities' capacity for contracting. However, the decentralization of local authority (particularly in the form of effective, functioning, elected local governments, which is a requisite for enhancing decentralized decision making), is only at an infant stage. Elected local councils are only a year old and government financial support for them is haphazard at best. The building of social capital is a gradual process, of which Sierra Leone is at the early stages, and the recently concluded decade-long civil conflict has obstructed the road to process completion. Thus, communities may have to witness the application of several different procurement approaches within their locality during reconstruction efforts, which will only add to their confusion.

The UNDP offers consultations with national governments on reconstruction needs. Projects are selected based on government-identified needs or a priority listing of infrastructure. The priorities of needs which are presented in sector categories (i.e., health, education, water and sanitation, etc.) provide the basis on which projects are selected. Prior to this, a series of consultations and negotiations were initiated to smooth out issues related to policies, procedures, and regulations between the UNDP and the recipient – in this case the GOSL. This planning process (including discussions to overcome bureaucratic huddles) takes considerable time due to the lack of trust in the government. In a bid to overcome the problem, the UNDP created the "Support to Resettlement and Reintegration Program" (SRRP) which now acts as a professional unit. The SRRP provides a quick survey of government priority listings of needs and prepares technical specifications and compressive bidding packages for tendering processes. The unit also plays a key role in the short-listing and selection of contractors for rehabilitation and reconstruction works. Supervision and monitoring of work progress is also carried out by this unit. It should be noted that a government is mandated to provide confirmation and formal commitment in providing the required staff for rehabilitated infrastructure facilities as a precondition to provision of funds.

The UK Department for International Development (DFID) has been taking the lead in the reestablishment of civil authority in Sierra Leone. The Sierra Leone Police Force provides technical support. Needs assessments are jointly carried out by the government security arm, DFID personnel, and the Sierra Leone Police technical team. In the majority of cases, design and preparation of a tender document package is outsourced to a private consultant. The consultant provides input into the selection of contractors and is responsible for overall supervision and coordination of project activities, with contributions from the DFID field engineer and the Sierra Leone Police technical team.

However, government policies and programmes are implemented largely within the context of the civil service structure of which ministries are the basic units. Departments and agencies that fall outside of this structure are also supervised or given policy oversight by a specific ministry. In this respect the management of ministries and the coordination of their activities in postwar reconstruction scenarios, at whatever level, are not properly defined. The government mandated postwar reconstruction wing, (the

NaCSA), could be characterized as an "initiatives reporting center" which, in most cases, is not informed about the intentions of donors' interventions.

In an attempt to overcome this condition, the office of the Sierra Leone Vice President is gradually being equipped with development management functions which put it in a crucial position. This process becomes essential when any of the coordinating institutions are deemed to be weak, or if an activity requires supervision, leadership, monitoring, or profile from a higher level, subordinate only to the office of the president. This has also ensured ministerial compliance and participation, whereas situations in which crucial issues had been left in the care of line ministries or commissions posed a challenge.

Appendix 5: The Liberian Civil War

The First Liberian Civil War erupted in December 1989, when the National Patriotic Front of Liberia (NPFL), an insurgent organization led by Charles Ghankay Taylor initiated civil war. As reported by the media[2], NPFL forces obtained their training in Libya and received their financial support from Libya, Burkina Faso, Ivory Coast, and Liberian opposition groups abroad. The Mano and Gios--(both groups comprise about 15 percent of the Liberian population and are linguistically related)--were compelled to join the rebellion against the Doe regime.

According to Amnesty International and reports by the United States Department of State "Liberian Country Report on Human Rights Practices," the NPFL committed massive human rights violation against the Liberian people. In Maryland and Lofa Counties, the NPFL had reportedly slain hundreds of civilians in its struggle against the Liberian Peace Council, another rebel group. The NPFL also robbed and kill unarmed civilians in Bong County during their flight in the wake of the struggle. In 1994, the NPFL was reported to have executed 80 of its own fighters without trial (Fitchett, 1992).

Although the Liberian Civil War was ignited by the brutal dictatorship of President Samuel Kanyon Doe, it was this factor coupled with the existence of underlying ethnic hatred which ultimately caused the crisis to implode. In fact, for over 174 years of its history, Liberian governments had fostered ethnic hatred and political dictatorship. Over 300,000 people perished in the fighting and almost every business establishment was destroyed. Over 10 percent of the population, mostly innocent civilians, were murdered; about three-quarters of the population became either refugees or displaced people; out of the 60 000 rebel fighters that had been recruited by the warlords, about 60 percent were "child soldiers", and most of them are now suffering from drug addiction, and post-traumatic stress syndrome. Women and girls were reported to have suffered the most: they were raped and murdered with impunity by all the warring factions. By 2004, the second stage of the Liberian Civil War had finally come to an end, and general elections were held. President Ellen Johnson-Sirleaf won the election.

[2] http://pages.prodigy.net/jkess3/civilwars.html; September, 14, 2007

Lofa County. Lofa County is one of the 15 administrative sub-divisions of the Republic of Liberia, located in the northernmost part of the county. It was created in 1964 by an act of legislation and subsequent executive order. It is bordered on the east and north by Guinea, on the west by Sierra Leone, and on the south by Gbarpolu and Bong counties. The county's administrative headquarters are located in the city of Voinjama.

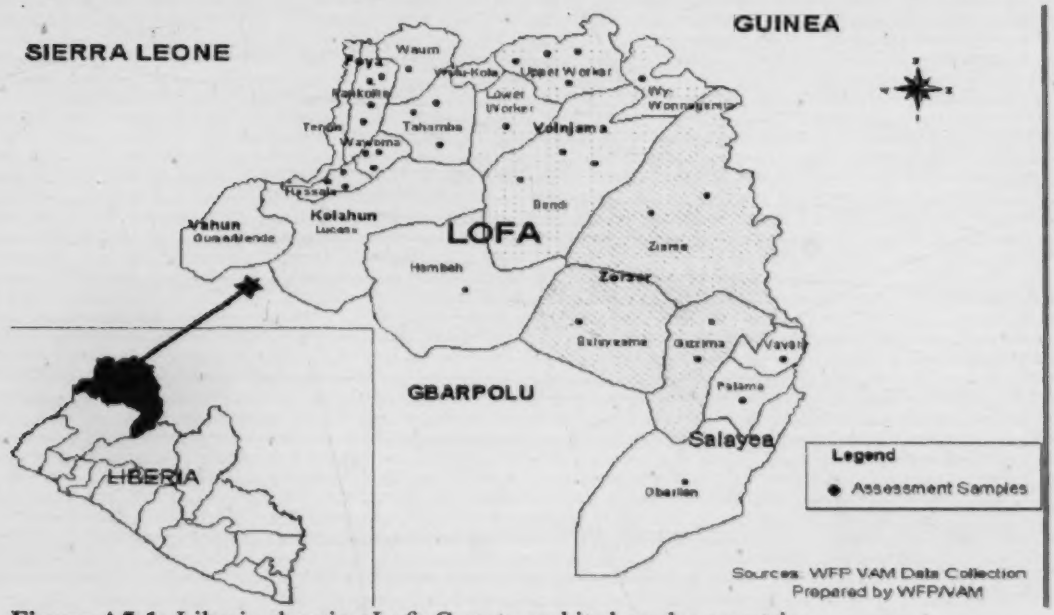


Figure A5-1: Liberia showing Lofa County and its boarder countries

The county is in turn divided into six administrative districts: Salayea, Zorzor, Voinjama, Kolahun, Foya, and Vahun. In 2004, Foya was declared a statutory district. Lofa had a pre-war population of about 339 112 (1984 census), but it has now fallen to a present value of 260 000. It is the second largest county in Liberia by area, spanning some 11 637 km^2.

Lofa County has a rich and diverse culture, as well as a well-developed traditional normative system that holds people together. This union is further expanded through the establishment of an age old initiation school system for boys and girls comprised of the "poro" and "sande" societies, respectively. Institutionalized practices may differ from one area to another and have certainly suffered major setbacks since the onset of the conflict. However, a basic education intended to facilitate the assumption of responsible roles in society is still embraced by the citizenry.

Six of the sixteen Liberian ethnic groups are represented in Lofa County. Table 7.1 outlines these ethnic groups and their religious preferences. Cardinal relations between the Loma and Mandingo ethnic groups have existed for several decades, with the 15 years of war and its aftermath having negative effects on this relationship over a series of issues.

Table A5-11: Lofa County ethnic groups and religious practices

	Mandingo	Lorma	Kpelle	Kissi	Gbandi	Mende
Muslim	√					√
Christian		√	√	√	√	√

Source: Survey Data

This degenerated relationship has been attributed specifically to issues of landownership, traditional practices, power sharing, etc. This has been further magnified by Liberian power politics and the scramble by the elite to have access to the rich mineral resources this county enjoys. The scenario most often results in a complete breakdown of law and order and gives rise to uncontrolled hostilities throughout the county.

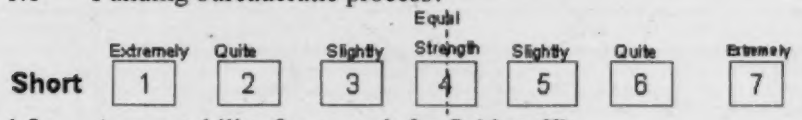
With a fertile soil, Lofa County had been known as Liberia's breadbasket prior to the civil crisis. Rice could be cultivated up to three times a year. The Lofa citizenry also engaged in commercial cultivation of coffee and palm nuts. The county is also rich in mineral resources; with diamond deposits in Vahun and Kolahun districts, iron ore in Voinjama's wologisi belt, and gold deposits in the Salayea District.

Appendix 6: Donor procedures and protocol evaluation questionnaire (FW2)

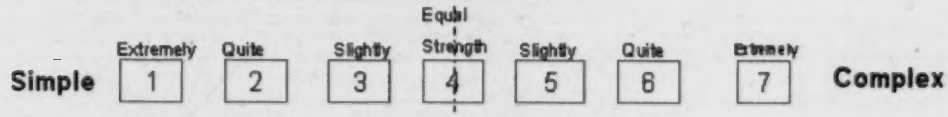
In order to gain a visual understanding of the perceptions and attitudes of donors who provide funds for this work, please provide candid ratings on the issues raised below.

Please rate the following characteristics of the donor institution:

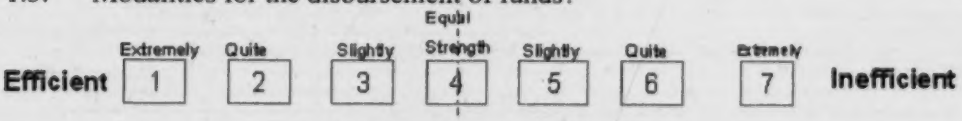
1.1 Funding bureaucratic process?



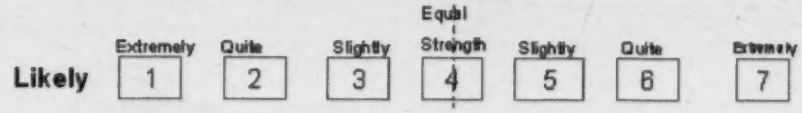
1.2 Accountability framework for field staff?



1.3. Modalities for the disbursement of funds?



1.4. Meeting future financial-assistance plans of the municipality?



Appendix 7: Curent Infrastructure situation (FW3)

The technical evaluators are required to look at the shape, pattern, location, as well as the length and width of the defect (e.g. cracks), based on three components of the physical infrastructure facility. A determination of the current condition of each component of the infrastructure is analyzed. For buildings, foundations, walls and supporting structures, and roofs are analyzed; for roads surface condition, bridges and subcomponents, culverts, and related structures are analyzed.

Section 1: Buildings

1.1 Please specify which of the following components of the building structure appear to remain a component of the building:
1. Roof 2. Walls and supporting structure 3. Foundation

Foundation:

1.2 Are there cracks on foundation walls?
A. Yes B. No

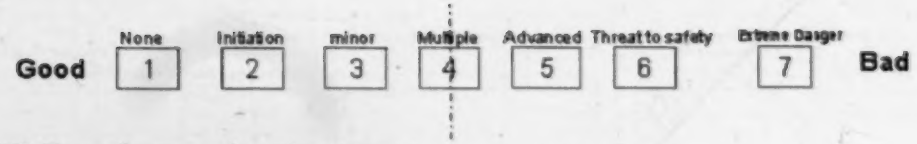
1.3. If yes, indicate which of the following defects is or are present?
A. Multiple cracks in one or more area
B. Cracks wider at the top than bottom
C. Cracks wider at bottom than top
D. Cracks are discontinuous
E. Cracks are uniform

1.4 From the type(s) of cracks identified above, which of the following is applicable?
A. Crack open to allow entry of rodents and other pets
B. Entry of water and excess moisture
C. Penetrate entire thickness of foundation
D. Loose materials over basement

1.5 Specify which of the following defect situations apply.
A. Differential settlement
B. Damage due to physical action
C. Growth of trees and penetration of roots
D. Chemical attack
E. Erosion and soil softening
F. Bulging
G. Rotting
H. Holes
F. Other _____ (specify)

Overall rating

Based upon the findings of your inspection, what would you conclude is the overall condition of the facility foundation? Use the bipolar scale below to make your evaluation.



Walls and supporting structures:

1.1 Specify which of the following critical defects apply.
A. Sag over a large area
B. Numerous cracks penetrating entire thickness of the wall
C. Bulging or deflection of a wall

1.2. Specify which of the following major defects apply.
A. Numerous cracks not penetrating entire thickness of wall
B. Degenerating material over large area
C. Large holes
D. Loose or missing material over large area
E. Sagging of limited area

1.3. Specify which of the following minor defects apply.
A. Hairline cracks over small area
B. Degenerating material over small area
C. Small holes
D. Loose or missing material over a limited area
E. Weathered exterior coverage

1.3. Does the facility contain porches and steps?
A. Yes B. No

1.4 If yes, please specify which of the following major defects apply to the porches and/or steps of the facility?
A. Degeneration over extensive area
B. Loose or missing material over extensive area
C. Cracks and holes over extensive area
D. Lack of adequate support

1.5. Please specify which of the following minor defects applies to the porches and/or steps of the facility?
A. Degeneration over limited area
B. Loose or missing material over limited area
C. Cracks and holes over limited area
D. Missing railings

1.6. Are there existing windows and window units?
A. Yes B. No

1.7. If yes, please specify which of the following major defects apply to the windows and window units of the facility.

A. Degeneration of frame elements
B. Loose or missing material to an extensive degree
D. Pronounced sagging of frame elements
E. Majority of window panes missing, cracked, or broken

1.8. Please specify which of the following minor defects applies to the windows and window units of the facility.
A. Degeneration over a limited area
B. Loose or missing material over a limited area
C. Some broken or cracked window panes

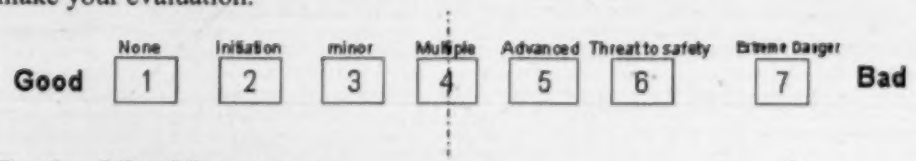
1.9. Are there existing doors and door units?
A. Yes B. No

1.10. If yes, please specify which of the following major defects applies to the doors and door units of the facility.
A. Openings that appear to be out of plumb
B. Absence of door(s)
C. Degeneration
D. Loose or missing material to an extensive degree

1.11. Please specify which of the following minor defects apply to the door and door units of the facility.
A. Degeneration over a limited area
B. Loose or missing material over a limited area
C. Limited wear or weathering

Overall rating

Based upon the findings of your inspection, what would you conclude is the overall condition of the facility wall and supporting structures? Use the bipolar scale below to make your evaluation.



Roof and Roof Structure:

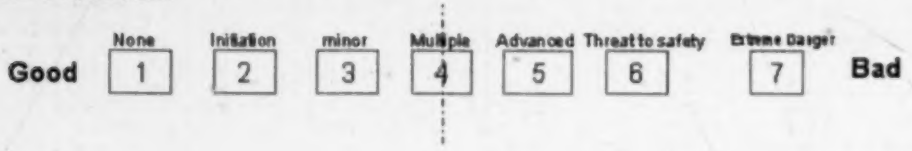
1.1 Specify which of the following critical defects apply.
A. Sagging at gutter line (eaves)
B. Degeneration of shingles or sheathing over most roof areas
C. Roof deck that is rotted, broken or missing material over a widespread area

1.2. Specify which of the following major defects applies.
A. Loose or missing materials over large area
B. Degenerating shingles
C. Degeneration on roof

1.3. Specify which of the following minor defects applies.
A. Weathered shingles over small area
B. Loose or missing material over small area
C. Degenerating trim

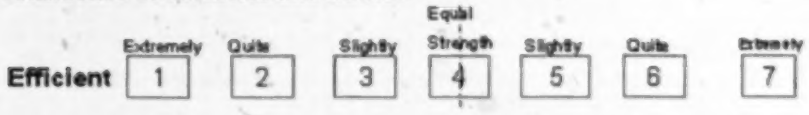
Overall rating

Based upon the findings of your inspection, what would you conclude is the overall condition of the facility roof and roof structures? Use the bipolar scale below to make your evaluation.

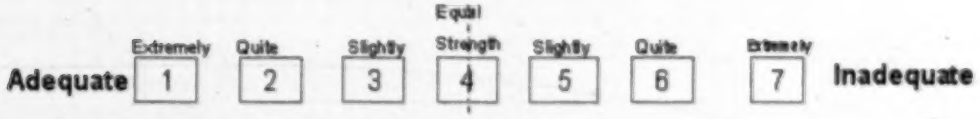


Appendix 8: Government National Priorities (FW4)

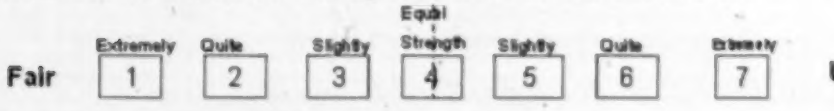
1.1. Government reforms (legal, social, economic, and environmental) that earn the confidence of investors and trades?



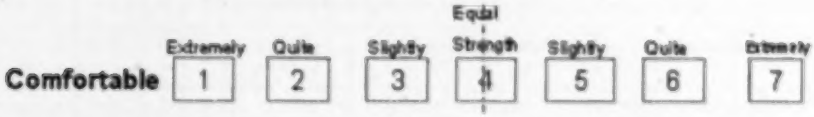
1.2. National networks which ensure long-term sustainability?



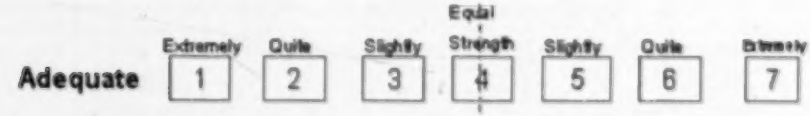
1.3. Procedures for the sharing of limited and scarce resources?



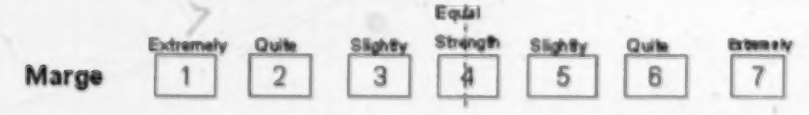
1.4. How do you describe the characteristics of the relationship between the government and the donor community?



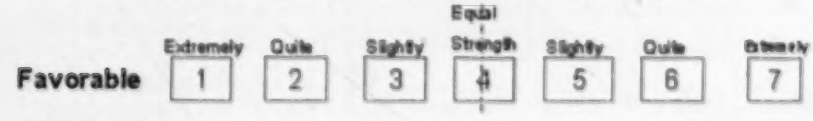
1.5. Role of government in coordinating nongovernmental organization (NGOs) activities?



1.6. Government endeavor to give greater weight to national policies and plans for the municipality and those of the donor?

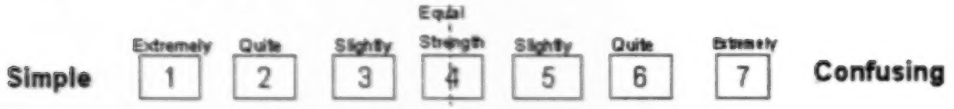


1.7. Generally, the climate for reconstruction initiatives and other social priorities between government, donors and the municipality is…

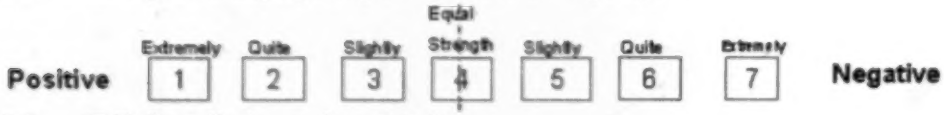


Appendix 9: Coordination Effectiveness (FW4)

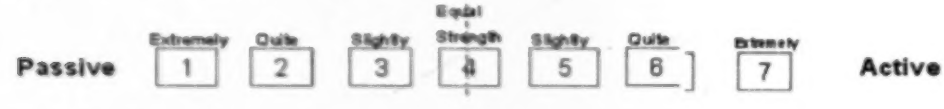
1.1. Framework for dispute resolution?



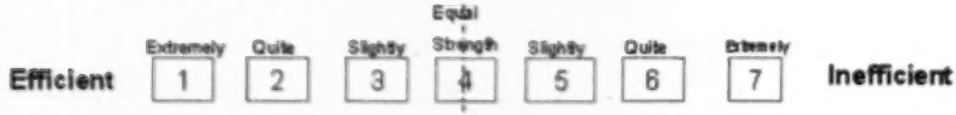
1.2. Acceptance of project by citizens of municipality?



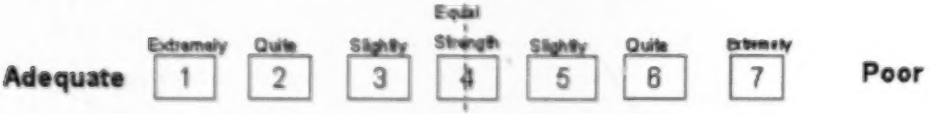
1.3. Tribal retaliation and protests?



1.4. The information flow network?



1.5. Operational collaboration with official bodies?



1.6. Relationship between reconstruction players?

Appendix 10: Fuzzy Rules for Postwar reconstruction allocation model

1. If (Sustainability-Gap is Very Low) then (Rating is Rate1) (0.006)
2. If (Sustainability-Gap is Low) then (Rating is Rate1) (0.006)
3. If (Sustainability-Gap is Medium) then (Rating is Rate2) (0.019)
4. If (Sustainability-Gap is High) then (Rating is Rate3) (0.063)
5. If (Sustainability-Gap is Very High) then (Rating is Rate4) (0.21)
6. If (Level-of-Destruction is Minor) then (Rating is Rate1) (0.006)
7. If (Level-of-Destruction is Moderate) then (Rating is Rate2) (0.019)
8. If (Level-of-Destruction is Major) then (Rating is Rate3) (0.063)
9. If (Donor-Preference-&-Protocol is Minor) then (Rating is Rate1) (0.006)
10. If (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate2) (0.019)
11. If (Donor-Preference-&-Protocol is High) then (Rating is Rate3) (0.063)
12. If (Government-Priorities is Minor) then (Rating is Rate1) (0.006)
13. If (Government-Priorities is Moderate) then (Rating is Rate2) (0.019)
14. If (Government-Priorities is High) then (Rating is Rate4) (0.21)
15. If (Coordination is Poor) then (Rating is Rate1) (0.006)
16. If (Coordination is Moderate) then (Rating is Rate2) (0.019)
17. If (Coordination is Good) then (Rating is Rate2) (0.019)
18. If (Sustainability-Gap is Very Low) and (Level-of-Destruction is Minor) then (Rating is Rate1) (0.006)
19. If (Sustainability-Gap is Very Low) and (Level-of-Destruction is Moderate) then (Rating is Rate2) (0.019)
20. If (Sustainability-Gap is Very Low) and (Level-of-Destruction is Major) then (Rating is Rate3) (0.063)
21. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) then (Rating is Rate1) (0.006)
22. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) then (Rating is Rate2) (0.019)
23. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) then (Rating is Rate3) (0.063)
24. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) then (Rating is Rate2) (0.019)
25. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) then (Rating is Rate3) (0.063)
26. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) then (Rating is Rate4) (0.21)
27. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) then (Rating is Rate3) (0.063)
28. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) then (Rating is Rate4) (0.21)
29. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) then (Rating is Rate5) (0.7)
30. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Minor) then (Rating is Rate3) (0.063)

31. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Moderate) then (Rating is Rate4) (0.21)
32. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Major) then (Rating is Rate5) (0.7)
33. If (Sustainability-Gap is Very Low) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate1) (0.006)
34. If (Sustainability-Gap is Very Low) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate2) (0.019)
35. If (Sustainability-Gap is Very Low) and (Donor-Preference-&-Protocol is High) then (Rating is Rate3) (0.063)
36. If (Sustainability-Gap is Low) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate1) (0.006)
37. If (Sustainability-Gap is Low) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate2) (0.019)
38. If (Sustainability-Gap is Low) and (Donor-Preference-&-Protocol is High) then (Rating is Rate3) (0.063)
39. If (Sustainability-Gap is Medium) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate2) (0.019)
40. If (Sustainability-Gap is Medium) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate3) (0.063)
41. If (Sustainability-Gap is Medium) and (Donor-Preference-&-Protocol is High) then (Rating is Rate3) (0.063)
42. If (Sustainability-Gap is High) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate4) (0.21)
43. If (Sustainability-Gap is High) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate3) (0.063)
44. If (Sustainability-Gap is High) and (Donor-Preference-&-Protocol is High) then (Rating is Rate5) (0.7)
45. If (Sustainability-Gap is Very High) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate4) (0.21)
46. If (Sustainability-Gap is Very High) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate3) (0.063)
47. If (Sustainability-Gap is Very High) and (Donor-Preference-&-Protocol is High) then (Rating is Rate5) (0.7)
48. If (Sustainability-Gap is Very Low) and (Government-Priorities is Minor) then (Rating is Rate1) (0.006)
49. If (Sustainability-Gap is Very Low) and (Government-Priorities is Moderate) then (Rating is Rate2) (0.019)
50. If (Sustainability-Gap is Very Low) and (Government-Priorities is High) then (Rating is Rate4) (0.21)
51. If (Sustainability-Gap is Low) and (Government-Priorities is Minor) then (Rating is Rate1) (0.006)
52. If (Sustainability-Gap is Low) and (Government-Priorities is Moderate) then (Rating is Rate2) (0.019)
53. If (Sustainability-Gap is Low) and (Government-Priorities is High) then (Rating is Rate4) (0.21)

54. If (Sustainability-Gap is Medium) and (Government-Priorities is Minor) then (Rating is Rate2) (0.019)
55. If (Sustainability-Gap is Medium) and (Government-Priorities is Moderate) then (Rating is Rate3) (0.063)
56. If (Sustainability-Gap is Medium) and (Government-Priorities is High) then (Rating is Rate4) (0.21)
57. If (Sustainability-Gap is High) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
58. If (Sustainability-Gap is High) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
59. If (Sustainability-Gap is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
60. If (Sustainability-Gap is Very High) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
61. If (Sustainability-Gap is Very High) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
62. If (Sustainability-Gap is Very High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
63. If (Sustainability-Gap is Very Low) and (Coordination is Poor) then (Rating is Rate1) (0.006)
64. If (Sustainability-Gap is Very Low) and (Coordination is Moderate) then (Rating is Rate2) (0.019)
65. If (Sustainability-Gap is Very_Low) and (Coordination is Good) then (Rating is Rate2) (0.019)
66. If (Sustainability-Gap is Low) and (Coordination is Poor) then (Rating is Rate1) (0.006)
67. If (Sustainability-Gap is Low) and (Coordination is Moderate) then (Rating is Rate2) (0.019)
68. If (Sustainability-Gap is Low) and (Coordination is Good) then (Rating is Rate2) (0.019)
69. If (Sustainability-Gap is Medium) and (Coordination is Poor) then (Rating is Rate2) (0.019)
70. If (Sustainability-Gap is Medium) and (Coordination is Moderate) then (Rating is Rate3) (0.063)
71. If (Sustainability-Gap is Medium) and (Coordination is Good) then (Rating is Rate3) (0.063)
72. If (Sustainability-Gap is High) and (Coordination is Poor) then (Rating is Rate3) (0.063)
73. If (Sustainability-Gap is High) and (Coordination is Moderate) then (Rating is Rate4) (0.21)
74. If (Sustainability-Gap is High) and (Coordination is Good) then (Rating is Rate4) (0.21)
75. If (Sustainability-Gap is Very High) and (Coordination is Poor) then (Rating is Rate3) (0.063)
76. If (Sustainability-Gap is Very High) and (Coordination is Moderate) then (Rating is Rate4) (0.21)

77. If (Sustainability-Gap is Very High) and (Coordination is Good) then (Rating is Rate4) (0.21)
78. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate2) (0.019)
79. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate1) (0.006)
80. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) then (Rating is Rate3) (0.063)
81. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate3) (0.063)
82. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate2) (0.019)
83. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) then (Rating is Rate4) (0.21)
84. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate4) (0.21)
85. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate3) (0.063)
86. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) then (Rating is Rate5) (0.7)
87. If (Level-of-Destruction is Minor) and (Government-Priorities is Minor) then (Rating is Rate1) (0.006)
88. If (Level-of-Destruction is Minor) and (Government-Priorities is Moderate) then (Rating is Rate2) (0.019)
89. If (Level-of-Destruction is Minor) and (Government-Priorities is High) then (Rating is Rate4) (0.21)
90. If (Level-of-Destruction is Moderate) and (Government-Priorities is Minor) then (Rating is Rate2) (0.019)
91. If (Level-of-Destruction is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate3) (0.063)
92. If (Level-of-Destruction is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
93. If (Level-of-Destruction is Major) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
94. If (Level-of-Destruction is Major) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
95. If (Level-of-Destruction is Major) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
96. If (Level-of-Destruction is Minor) and (Coordination is Poor) then (Rating is Rate1) (0.006)
97. If (Level-of-Destruction is Minor) and (Coordination is Moderate) then (Rating is Rate2) (0.019)
98. If (Level-of-Destruction is Minor) and (Coordination is Good) then (Rating is Rate2) (0.019)
99. If (Level-of-Destruction is Moderate) and (Coordination is Poor) then (Rating is Rate2) (0.019)

100. If (Level-of-Destruction is Moderate) and (Coordination is Moderate) then (Rating is Rate3) (0.063)
101. If (Level-of-Destruction is Moderate) and (Coordination is Good) then (Rating is Rate3) (0.063)
102. If (Level-of-Destruction is Major) and (Coordination is Poor) then (Rating is Rate3) (0.063)
103. If (Level-of-Destruction is Major) and (Coordination is Moderate) then (Rating is Rate4) (0.21)
104. If (Level-of-Destruction is Major) and (Coordination is Good) then (Rating is Rate4) (0.21)
105. If (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate2) (0.019)
106. If (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate3) (0.063)
107. If (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
108. If (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate1) (0.006)
109. If (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate2) (0.019)
110. If (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate4) (0.21)
111. If (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
112. If (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
113. If (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
114. If (Donor-Preference-&-Protocol is Moderate) and (Coordination is Poor) then (Rating is Rate2) (0.019)
115. If (Donor-Preference-&-Protocol is Moderate) and (Coordination is Moderate) then (Rating is Rate3) (0.063)
116. If (Donor-Preference-&-Protocol is Moderate) and (Coordination is Good) then (Rating is Rate3) (0.063)
117. If (Donor-Preference-&-Protocol is Minor) and (Coordination is Poor) then (Rating is Rate1) (0.006)
118. If (Donor-Preference-&-Protocol is Minor) and (Coordination is Moderate) then (Rating is Rate2) (0.019)
119. If (Donor-Preference-&-Protocol is Minor) and (Coordination is Good) then (Rating is Rate2) (0.019)
120. If (Donor-Preference-&-Protocol is High) and (Coordination is Poor) then (Rating is Rate3) (0.063)
121. If (Donor-Preference-&-Protocol is High) and (Coordination is Moderate) then (Rating is Rate4) (0.21)
122. If (Donor-Preference-&-Protocol is High) and (Coordination is Good) then (Rating is Rate4) (0.21)

123. If (Government-Priorities is Minor) and (Coordination is Poor) then (Rating is Rate1) (0.006)
124. If (Government-Priorities is Minor) and (Coordination is Moderate) then (Rating is Rate2) (0.019)
125. If (Government-Priorities is Minor) and (Coordination is Good) then (Rating is Rate4) (0.21)
126. If (Government-Priorities is Moderate) and (Coordination is Poor) then (Rating is Rate2) (0.019)
127. If (Government-Priorities is Moderate) and (Coordination is Moderate) then (Rating is Rate3) (0.063)
128. If (Government-Priorities is Moderate) and (Coordination is Good) then (Rating is Rate5) (0.7)
129. If (Government-Priorities is High) and (Coordination is Poor) then (Rating is Rate2) (0.019)
130. If (Government-Priorities is High) and (Coordination is Moderate) then (Rating is Rate3) (0.063)
131. If (Government-Priorities is High) and (Coordination is Good) then (Rating is Rate5) (0.7)
132. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate2) (0.019)
133. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate1) (0.006)
134. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) then (Rating is Rate3) (0.063)
135. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate3) (0.063)
136. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate2) (0.019)
137. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) then (Rating is Rate4) (0.21)
138. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate4) (0.21)
139. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate4) (0.21)
140. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) then (Rating is Rate5) (0.7)
141. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate2) (0.019)
142. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate1) (0.006)
143. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) then (Rating is Rate3) (0.063)
144. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate3) (0.063)
145. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate2) (0.019)

146. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) then (Rating is Rate4) (0.21)
147. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate4) (0.21)
148. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate4) (0.21)
149. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) then (Rating is Rate5) (0.7)
150. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate3) (0.063)
151. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate3) (0.063)
152. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) then (Rating is Rate4) (0.21)
153. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate4) (0.21)
154. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate3) (0.063)
155. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) then (Rating is Rate5) (0.7)
156. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate5) (0.7)
157. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate4) (0.21)
158. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) then (Rating is Rate5) (0.7)
159. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate4) (0.21)
160. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate3) (0.063)
161. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) then (Rating is Rate5) (0.7)
162. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate5) (0.7)
163. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate4) (0.21)
164. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) then (Rating is Rate5) (0.7)
165. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate5) (0.7)
166. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate5) (0.7)
167. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) then (Rating is Rate5) (0.7)
168. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate4) (0.21)

169. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate3) (0.063)
170. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) then (Rating is Rate5) (0.7)
171. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate5) (0.7)
172. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate4) (0.21)
173. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) then (Rating is Rate5) (0.7)
174. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) then (Rating is Rate5) (0.7)
175. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) then (Rating is Rate5) (0.7)
176. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) then (Rating is Rate5) (0.7)
177. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Minor) and (Government-Priorities is Minor) then (Rating is Rate1) (0.006)
178. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Minor) and (Government-Priorities is Moderate) then (Rating is Rate2) (0.019)
179. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Minor) and (Government-Priorities is High) then (Rating is Rate3) (0.063)
180. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Moderate) and (Government-Priorities is Minor) then (Rating is Rate2) (0.019)
181. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate3) (0.063)
182. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Moderate) and (Government-Priorities is High) then (Rating is Rate4) (0.21)
183. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Major) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
184. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Major) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
185. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Major) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
186. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) and (Government-Priorities is Minor) then (Rating is Rate1) (0.006)
187. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) and (Government-Priorities is Moderate) then (Rating is Rate2) (0.019)
188. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) and (Government-Priorities is High) then (Rating is Rate3) (0.063)
189. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) and (Government-Priorities is Minor) then (Rating is Rate2) (0.019)
190. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate3) (0.063)
191. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) and (Government-Priorities is High) then (Rating is Rate4) (0.21)

192. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
193. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
194. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
195. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
196. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) and (Government-Priorities is Moderate) then (Rating is Rate3) (0.063)
197. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
198. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
199. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
200. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
201. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
202. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
203. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
204. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
205. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
206. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
207. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
208. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
209. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
210. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) and (Government-Priorities is Minor) then (Rating is Rate5) (0.7)
211. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
212. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
213. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Minor) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
214. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Minor) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)

215. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Minor) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
216. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Moderate) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
217. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
218. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
219. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Major) and (Government-Priorities is Minor) then (Rating is Rate5) (0.7)
220. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Major) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
221. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Major) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
222. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Minor) and (Coordination is Poor) then (Rating is Rate1) (0.006)
223. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Minor) and (Coordination is Moderate) then (Rating is Rate2) (0.019)
224. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Minor) and (Coordination is Good) then (Rating is Rate3) (0.063)
225. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Moderate) and (Coordination is Poor) then (Rating is Rate2) (0.019)
226. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Moderate) and (Coordination is Moderate) then (Rating is Rate3) (0.063)
227. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Moderate) and (Coordination is Good) then (Rating is Rate3) (0.063)
228. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Major) and (Coordination is Poor) then (Rating is Rate3) (0.063)
229. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Major) and (Coordination is Moderate) then (Rating is Rate4) (0.21)
230. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Major) and (Coordination is Good) then (Rating is Rate4) (0.21)
231. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) and (Coordination is Poor) then (Rating is Rate1) (0.006)
232. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) and (Coordination is Moderate) then (Rating is Rate2) (0.019)
233. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) and (Coordination is Good) then (Rating is Rate3) (0.063)
234. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) and (Coordination is Poor) then (Rating is Rate2) (0.019)
235. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) and (Coordination is Moderate) then (Rating is Rate3) (0.063)
236. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) and (Coordination is Good) then (Rating is Rate3) (0.063)
237. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) and (Coordination is Poor) then (Rating is Rate3) (0.063)

238. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) and (Coordination is Moderate) then (Rating is Rate4) (0.21)
239. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) and (Coordination is Good) then (Rating is Rate4) (0.21)
240. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) and (Coordination is Poor) then (Rating is Rate2) (0.019)
241. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) and (Coordination is Moderate) then (Rating is Rate3) (0.063)
242. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) and (Coordination is Good) then (Rating is Rate3) (0.063)
243. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) and (Coordination is Poor) then (Rating is Rate3) (0.063)
244. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) and (Coordination is Moderate) then (Rating is Rate4) (0.21)
245. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) and (Coordination is Good) then (Rating is Rate4) (0.21)
246. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) and (Coordination is Poor) then (Rating is Rate4) (0.21)
247. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) and (Coordination is Moderate) then (Rating is Rate5) (0.7)
248. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) and (Coordination is Good) then (Rating is Rate5) (0.7)
249. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) and (Coordination is Poor) then (Rating is Rate3) (0.063)
250. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) and (Coordination is Moderate) then (Rating is Rate4) (0.21)
251. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) and (Coordination is Good) then (Rating is Rate4) (0.21)
252. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) and (Coordination is Poor) then (Rating is Rate4) (0.21)
253. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) and (Coordination is Moderate) then (Rating is Rate5) (0.7)
254. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) and (Coordination is Good) then (Rating is Rate5) (0.7)
255. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) and (Coordination is Poor) then (Rating is Rate5) (0.7)
256. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) and (Coordination is Moderate) then (Rating is Rate5) (0.7)
257. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) and (Coordination is Good) then (Rating is Rate5) (0.7)
258. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Minor) and (Coordination is Poor) then (Rating is Rate3) (0.063)
259. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Minor) and (Coordination is Moderate) then (Rating is Rate4) (0.21)
260. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Minor) and (Coordination is Good) then (Rating is Rate4) (0.21)

261. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Moderate) and (Coordination is Poor) then (Rating is Rate4) (0.21)
262. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Moderate) and (Coordination is Moderate) then (Rating is Rate5) (0.7)
263. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Moderate) and (Coordination is Good) then (Rating is Rate5) (0.7)
264. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Major) and (Coordination is Poor) then (Rating is Rate5) (0.7)
265. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Major) and (Coordination is Moderate) then (Rating is Rate5) (0.7)
266. If (Sustainability-Gap is Very_High) and (Level-of-Destruction is Major) and (Coordination is Good) then (Rating is Rate5) (0.7)
267. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate2) (0.019)
268. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate3) (0.063)
269. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
270. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate1) (0.006)
271. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate2) (0.019)
272. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate4) (0.21)
273. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
274. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
275. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
276. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
277. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
278. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
279. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate2) (0.019)
280. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate3) (0.063)
281. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
282. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
283. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)

284. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
285. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
286. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
287. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
288. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
289. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
290. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
291. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate5) (0.7)
292. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
293. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
294. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Coordination is Poor) then (Rating is Rate2) (0.019)
295. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Coordination is Moderate) then (Rating is Rate3) (0.063)
296. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Coordination is Good) then (Rating is Rate3) (0.063)
297. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Coordination is Poor) then (Rating is Rate1) (0.006)
298. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Coordination is Moderate) then (Rating is Rate2) (0.019)
299. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Coordination is Good) then (Rating is Rate2) (0.019)
300. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Coordination is Poor) then (Rating is Rate3) (0.063)
301. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Coordination is Moderate) then (Rating is Rate4) (0.21)
302. If (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Coordination is Good) then (Rating is Rate4) (0.21)
303. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Coordination is Poor) then (Rating is Rate3) (0.063)
304. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Coordination is Moderate) then (Rating is Rate4) (0.21)
305. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Coordination is Good) then (Rating is Rate4) (0.21)
306. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Coordination is Poor) then (Rating is Rate2) (0.019)

307. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Coordination is Moderate) then (Rating is Rate3) (0.063)
308. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Coordination is Good) then (Rating is Rate4) (0.21)
309. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Coordination is Poor) then (Rating is Rate4) (0.21)
310. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Coordination is Moderate) then (Rating is Rate5) (0.7)
311. If (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Coordination is Good) then (Rating is Rate5) (0.7)
312. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Coordination is Poor) then (Rating is Rate4) (0.21)
313. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Coordination is Moderate) then (Rating is Rate5) (0.7)
314. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Coordination is Good) then (Rating is Rate5) (0.7)
315. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Coordination is Poor) then (Rating is Rate3) (0.063)
316. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Coordination is Moderate) then (Rating is Rate4) (0.21)
317. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Coordination is Good) then (Rating is Rate4) (0.21)
318. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Coordination is Poor) then (Rating is Rate5) (0.7)
319. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Coordination is Moderate) then (Rating is Rate5) (0.7)
320. If (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Coordination is Good) then (Rating is Rate5) (0.7)
321. If (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) and (Coordination is Poor) then (Rating is Rate2) (0.019)
322. If (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) and (Coordination is Moderate) then (Rating is Rate3) (0.063)
323. If (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) and (Coordination is Good) then (Rating is Rate5) (0.7)
324. If (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) and (Coordination is Poor) then (Rating is Rate3) (0.063)
325. If (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) and (Coordination is Moderate) then (Rating is Rate3) (0.063)
326. If (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) and (Coordination is Good) then (Rating is Rate5) (0.7)
327. If (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) and (Coordination is Poor) then (Rating is Rate3) (0.063)
328. If (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) and (Coordination is Moderate) then (Rating is Rate4) (0.21)
329. If (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) and (Coordination is Good) then (Rating is Rate5) (0.7)

330. If (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) and (Coordination is Poor) then (Rating is Rate1) (0.006)
331. If (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) and (Coordination is Moderate) then (Rating is Rate2) (0.019)
332. If (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) and (Coordination is Good) then (Rating is Rate3) (0.063)
333. If (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) and (Coordination is Poor) then (Rating is Rate2) (0.019)
334. If (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) and (Coordination is Moderate) then (Rating is Rate3) (0.063)
335. If (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) and (Coordination is Good) then (Rating is Rate5) (0.7)
336. If (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) and (Coordination is Poor) then (Rating is Rate2) (0.019)
337. If (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) and (Coordination is Moderate) then (Rating is Rate3) (0.063)
338. If (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) and (Coordination is Good) then (Rating is Rate5) (0.7)
339. If (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) and (Coordination is Poor) then (Rating is Rate3) (0.063)
340. If (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) and (Coordination is Moderate) then (Rating is Rate4) (0.21)
341. If (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) and (Coordination is Good) then (Rating is Rate5) (0.7)
342. If (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) and (Coordination is Poor) then (Rating is Rate4) (0.21)
343. If (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) and (Coordination is Moderate) then (Rating is Rate5) (0.7)
344. If (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) and (Coordination is Good) then (Rating is Rate5) (0.7)
345. If (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) and (Coordination is Poor) then (Rating is Rate4) (0.21)
346. If (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) and (Coordination is Moderate) then (Rating is Rate5) (0.7)
347. If (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) and (Coordination is Good) then (Rating is Rate5) (0.7)
348. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate2) (0.019)
349. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate3) (0.063)
350. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)

351. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate1) (0.006)
352. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate2) (0.019)
353. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate4) (0.21)
354. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
355. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
356. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
357. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate2) (0.019)
358. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate3) (0.063)
359. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
360. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate2) (0.019)
361. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate3) (0.063)
362. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate4) (0.21)
363. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
364. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
365. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)

366. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
367. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
368. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
369. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
370. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
371. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
372. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate5) (0.7)
373. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
374. If (Sustainability-Gap is Very_Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
375. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate2) (0.019)
376. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate3) (0.063)
377. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
378. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate1) (0.006)
379. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate2) (0.019)
380. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate4) (0.21)

381. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
382. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
383. If (Sustainability-Gap is Low) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
384. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate2) (0.019)
385. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate3) (0.063)
386. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
387. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate2) (0.019)
388. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate2) (0.019)
389. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate4) (0.21)
390. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
391. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
392. If (Sustainability-Gap is Low) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
393. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
394. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
395. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)

396. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
397. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
398. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
399. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate5) (0.7)
400. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
401. If (Sustainability-Gap is Low) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
402. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate2) (0.019)
403. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
404. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
405. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate2) (0.019)
406. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate3) (0.063)
407. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
408. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
409. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
410. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)

411. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
412. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate3) (0.063)
413. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
414. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate2) (0.019)
415. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate3) (0.063)
416. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
417. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
418. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
419. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
420. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
421. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
422. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
423. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
424. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
425. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate5) (0.7)

426. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate5) (0.7)
427. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
428. If (Sustainability-Gap is Medium) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
429. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
430. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
431. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
432. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
433. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
434. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
435. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
436. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
437. If (Sustainability-Gap is High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
438. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
439. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
440. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)

441. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
442. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
443. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
444. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate5) (0.7)
445. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
446. If (Sustainability-Gap is High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
447. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate5) (0.7)
448. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
449. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
450. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
451. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
452. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
453. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate5) (0.7)
454. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
455. If (Sustainability-Gap is High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)

456. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
457. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
458. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
459. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate3) (0.063)
460. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate4) (0.21)
461. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
462. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
463. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
464. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Minor) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
465. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
466. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
467. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
468. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
469. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
470. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate5) (0.7)

471. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate5) (0.7)
472. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
473. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Moderate) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
474. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Minor) then (Rating is Rate5) (0.7)
475. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
476. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Moderate) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
477. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Minor) then (Rating is Rate4) (0.21)
478. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
479. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is Minor) and (Government-Priorities is High) then (Rating is Rate5) (0.7)
480. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Minor) then (Rating is Rate5) (0.7)
481. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is Moderate) then (Rating is Rate5) (0.7)
482. If (Sustainability-Gap is Very High) and (Level-of-Destruction is Major) and (Donor-Preference-&-Protocol is High) and (Government-Priorities is High) then (Rating is Rate5) (0.7)